Aviation Week
and Space Technology

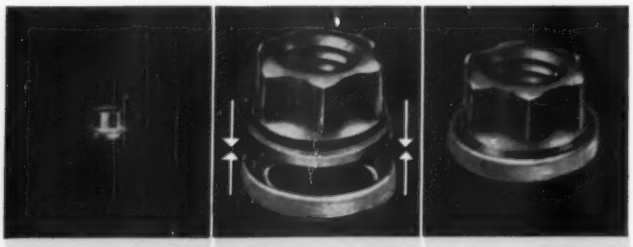
October 10, 1960

Aircraft Tested For Missile Site Support Work

Kaylock® 'captive washer' nut gains wide acceptance!

Since its introduction early in 1960, this new Kaylock® lightweight, all-metal self-locking nut with integral free-spinning metal washer has been specified by leading aerospace manufacturers for an increasing number of applications. Separate washers that used to drop off, roll away, and slide into hard-to-get-at places have been eliminated. The danger of short circuits, due to these forgotten washers, also has been eliminated by the new Kaylock HW14 nut-washer combination.

Saves Assembly Time. Kaylock HW14's cut extra motion required to put washer on bolt. Washer can't drop off during application or removal. Cuts time lost looking for wayward washers.. *to zero! Safer, too!* Kaylock HW14 "captive washer" nuts employ the same, sure elliptical locking principle to prevent vibration hazards. The Kaylock HW14 is a development of Kaynar Mfg. Co., Inc., world's oldest and largest manufacturer of lightweight, all-metal self-locking nuts. For complete details, call your nearest Kaylock representative.



The Kaylock HW14 is available in size -02 (shown above) and in other sizes to -3.

View of Kaylock HW14-3 and washer prior to assembly.

Assembled HW14-3. Integral, free-spinning washer can't drop off. Only one part to handle instead of two.

Kaylock®
first in lightweight locknuts

KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2001, Terminal Annex, Los Angeles 54, Calif. Branch offices, warehouses & representatives in Wichita, Kan.; New York, N.Y.; Atlanta, Ga.; Renton, Wash.; Montreal; Paris; London; The Hague

CASSEGRAIN ANTENNAS: another prime capability of Goodyear Aircraft

1 48-inch transmitting & receiving antennas for U. S. Army Hawk missile

ON REFLECTION, THEY AGREED ON GAC!

Plastic radar reflectors—as pioneered by Goodyear—offer better return on investment because (1) light weight means higher performance, (2) tooling-up is less costly; so are design changes, (3) high impact strength takes dents, hard knocks, (4) plastic fights corrosion, chemicals. Also, plastic offers important insulating, vibration-damping qualities, is readily formed into difficult shapes and is easily repaired. Add Goodyear's long experience in designing, fabricating, erecting and testing in reinforced plastics, metal sandwich-type materials, and structural metals, and you too will specify Goodyear Aircraft Corporation—the source of supply that handles the *entire* job to your specification. For more information, write Goodyear Aircraft Corporation, Dept. 916AV, Akron 15, Ohio.

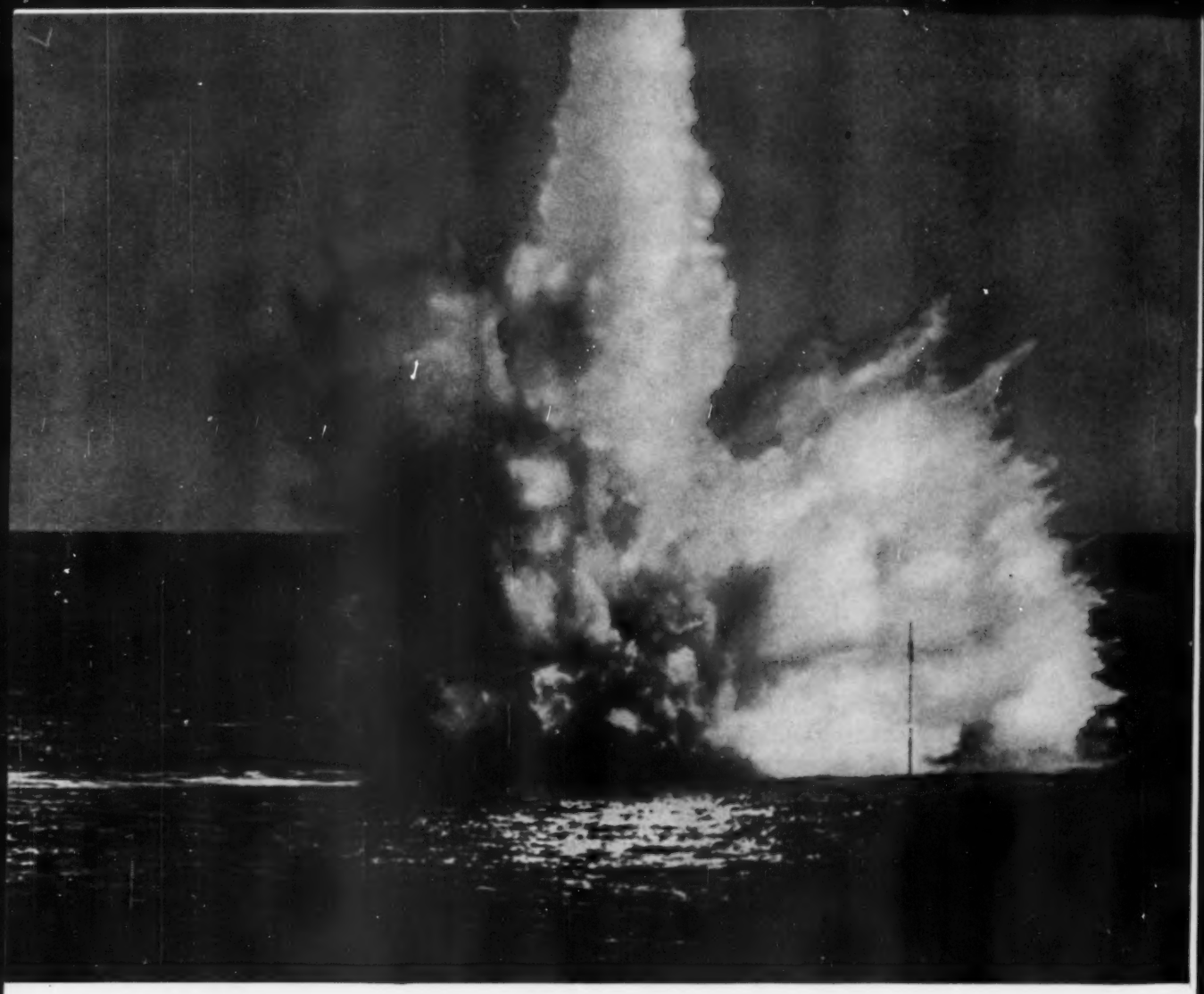
Lots of good things come from

GOODYEAR AIRCRAFT

Plants in Akron, Ohio, and Litchfield Park, Arizona | *Providing all 3 weapon system skills* MANUFACTURE

2 Navy missile cruisers employ this large reflector

3 92-inch Cassegrain antenna built for U. S. Army Nike-Hercules radar



The Polaris will locate and destroy its target some 1200 miles away with the help of Raytheon Weld-Pak circuit modules. These Weld-Pak units, based on an M.I.T. Instrumentation Laboratory packaging concept, are vital elements of the Polaris guidance system. Polaris is one of 22 U.S. Missiles that rely on Raytheon components and equipment.

RAYTHEON COMPANY

WALTHAM, MASSACHUSETTS

RAYTHEON

AVIATION CALENDAR

Oct. 17-18—Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Queen Elizabeth Hotel, Montreal, Canada.

Oct. 17-21—National Safety Council's 48th National Safety Congress, Conrad Hilton Hotel, Chicago, Ill.

Oct. 19-21—Annual Convention, Southeastern Airport Managers' Assn., Far Horizons Motel, Sarasota-Bradenton, Fla.

Oct. 19-21—Symposium on Space Navigation, Institute of Radio Engineers, Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 19-21—Annual Meeting, Society for Experimental Stress Analysis, Hotel Claremont, Berkeley, Calif.

Oct. 20-21—National Symposium on Hypervelocity Techniques, Institute of the Aeronautical Sciences, Shirley-Savoy Hotel, Denver, Colo.

Oct. 20-21—First Annual Air Force Aero Club Congress, Tinker AFB, Okla.

Oct. 24-25—Mid-Year Conference, Airport Operators Council, San Francisco, Calif.

Oct. 24-26—Medical and Biological Aspects of the Energies of Space, Unclassified Symposium, Granada Hotel, San Antonio, Tex. Sponsored by the School of Aviation Medicine. Arranged by Southwest Research Institute.

Oct. 24-26—Seventh East Coast Conference on Aeronautical and Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Oct. 25-27—11th National Conference on Standards, Sheraton-Atlantic Hotel, N.Y.C.

Oct. 27-28—1960 Annual Electron Devices Meeting, Institute of Radio Engineers, Hotel Shoreham, Washington, D. C.

Oct. 27-29—1960 Industry Display, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

(Continued on page 6)

AVIATION WEEK and Space Technology

October 10, 1960

Vol. 73, No. 15

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription order.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada $8 one year. All other countries, $20 one year.

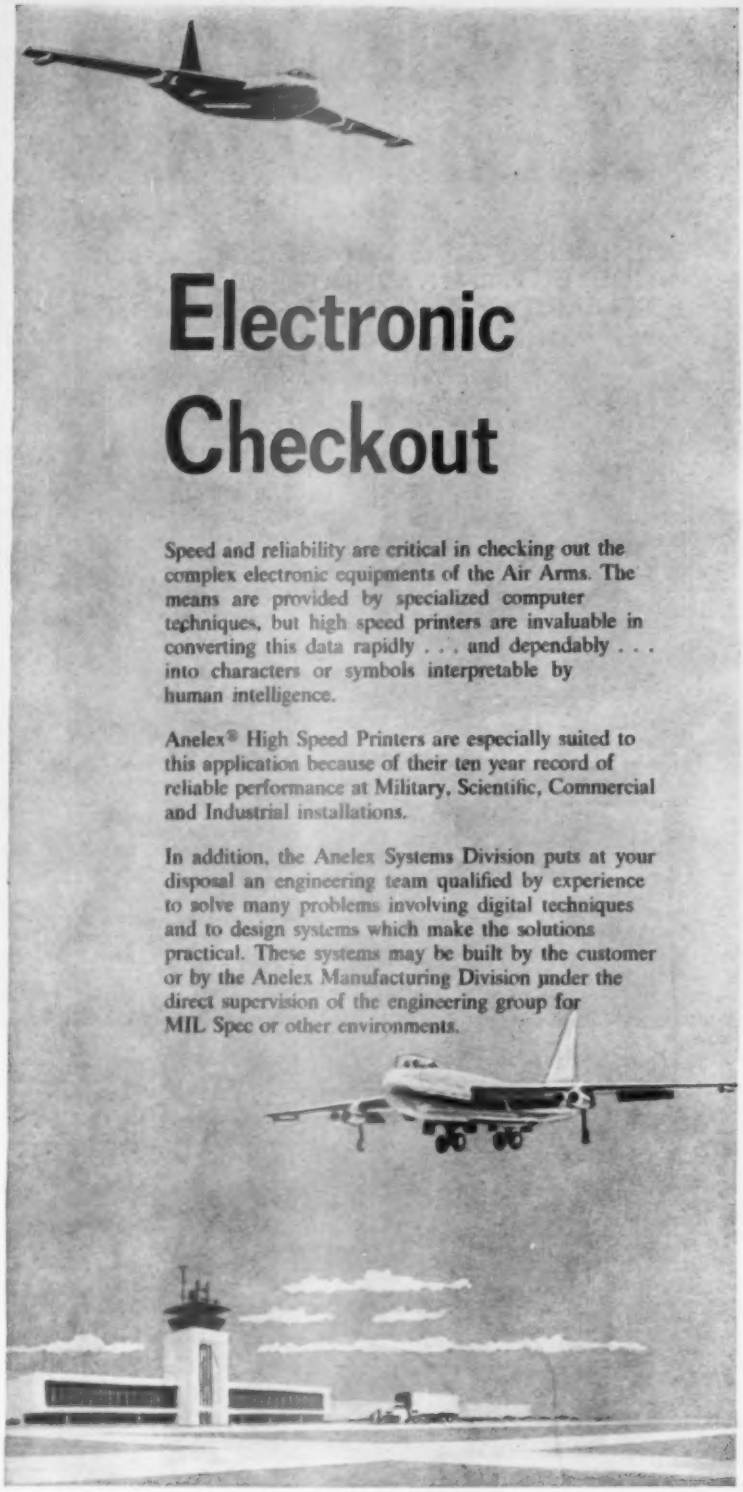
Any subscriber who is dissatisfied with this publication for any reason whatever, may cancel his subscription by writing our Fulfillment Manager. Refund for unexpired portion of subscription will be made promptly.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.

©Copyright 1960 by McGraw-Hill Publishing Co. Inc. **All rights reserved. Cable Address: "McGraw-Hill New York."** Publications combined with AVIATION WEEK and SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to **Fulfillment Manager**, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Fulfillment Manager, Aviation Week and Space Technology, 330 West 42nd Street, New York 36, N. Y.


Electronic
Checkout
Speed and reliability are critical in checking out the complex electronic equipments of the Air Arms. The means are provided by specialized computer techniques, but high speed printers are invaluable in converting this data rapidly . . . and dependably . . . into characters or symbols interpretable by human intelligence.
Anelex® High Speed Printers are especially suited to this application because of their ten year record of reliable performance at Military, Scientific, Commercial and Industrial installations.
In addition, the Anelex Systems Division puts at your disposal an engineering team qualified by experience to solve many problems involving digital techniques and to design systems which make the solutions practical. These systems may be built by the customer or by the Anelex Manufacturing Division under the direct supervision of the engineering group for MIL Spec or other environments.
for further information, write or telephone
ANELEX CORPORATION
150-B CAUSEWAY ST., BOSTON 14, MASS.
ANELEX

e·m·r SUBCARRIER DISCRIMINATOR

ALL SOLID STATE...PHASE-LOCK-LOOP DETECTION... MINIATURE... FOR TELEMETRY AND DATA REDUCTION

The new **e·m·r** Model 167A is a precision instrument designed for demodulating FM subcarrier signals with exceptional linearity. It employs phase-lock-loop detection in completely solid-state circuitry to achieve outstanding characteristics of performance and durability in a miniature package. It has a true 60-db dynamic input voltage range. Amplitude of each subcarrier signal can be as great as 5V rms in a multiplex of up to 18 subcarriers. Amplitude modulation effects such as tape dropouts are virtually eliminated by dynamic limiting, effective over a true 60-db voltage range.

Discriminator characteristics are automatically optimized regardless of channel selector used and output filter chosen. All standard IRIG center frequencies, frequency deviations, and intelligence frequency outputs are available. Two discriminators can be mounted side by side in a 19" rack, using a simple fastener.

CONDENSED SPECIFICATIONS

Center Frequency: IRIG standard; up to 300 KC available

Frequency Deviation: IRIG standard; up to ±40% available

Intelligence Frequency Output: IRIG standard; up to 60 KC available

Input Dynamic Range: 60 db, 5 mv to 5V rms

AM Rejection: less than 0.3% peak bandwidth change for 20 db input step change

Unwanted Signal Rejection: 60 db rejection of full scale modulation on adjacent channel having 16 db greater amplitude

Linearity: ±0.05% of bandwidth with respect to best straight line

Tape-speed Compensation: greater than 100:1 reduction of wow-and-flutter up to ±10% of center frequency

Output Stability: ±0.2% of bandwidth in 24 hrs. after 5 min. warm-up

Output: cal. output control adjustable ±1.0V to ±10V at 500 ma load (to 20 kc intelligence)

Power Consumption: 30W at 120V rms.

Size: 3½" x 8" panel; over-all depth, 18"

Meters: two cal. meters provided — Subcarrier amplitude and % band edge

For complete information contact:

Electro-Mechanical Research, inc.

P. O. Box 3041, Sarasota, Florida

AVIATION CALENDAR

(*Continued from page 5*)

Nov. 1-2—Fall Meeting, Radio Technical Commission for Aeronautics, Sheraton-Park Hotel, Washington, D. C.

Nov. 2-4—Tenth Aircraft Hydraulics Conference, Pick-Fort Shelby Hotel, Detroit, Mich., Sponsor: Vickers, Inc., division of Sperry Rand Corp. (Invitational.)

Nov. 3-4—Annual Fall Meeting, Northeast Chapter-American Assn. of Airport Executives, Sheraton Inn, Binghamton, N. Y.

Nov. 14-15—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Olympic Hotel, Seattle, Wash.

Nov. 14-16—National Convention, National Aeronautics Assn., Indio, Calif.

Nov. 14-17—Sixth Annual Conference on Magnetism and Magnetic Materials, New Yorker Hotel, New York, N. Y. Sponsors: American Institute of Electrical Engineers; American Institute of Physics; Office of Naval Research; Institute of Radio Engineers; American Institute of Mechanical Engineers.

Nov. 14-18—Flight Safety Foundation's 13th Annual International Air Safety Seminar, in cooperation with Aviation Crash Injury Research, Phoenix, Ariz. For FSF members and by invitation.

Nov. 15-16—Symposium on Engineering Application of Probability and Random Function Theory, Purdue University, Lafayette, Ind.

Nov. 15-16—12th Annual Mid-America Electronics Conference, Institute of Radio Engineers, Hotel Muehlebach, Kansas City, Mo.

Nov. 15-17—36th Meeting, Aviation Distributors and Manufacturers Assn., Riviera Hotel, Palm Springs, Calif.

Nov. 15-17—Air Force-Navy-Industry Propulsion Systems Lubricants Conference (unclassified), Hilton Hotel, San Antonio, Tex. Cosponsors: ARDC's Wright Air Development Division; Southwest Research Institute.

Dec. 5-8—15th Annual Meeting and Astronautical Exposition, American Rocket Society, Shoreham Hotel, Washington, D. C.

Dec. 6-8—Annual Meeting, National Aviation Trades Assn., Oklahoma-Biltmore, Oklahoma City, Okla.

Dec. 13-15—Tenth Annual Eastern Joint Computer Conference, Hotel New Yorker and Manhattan Center, New York, N. Y. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Assn. for Computing Machinery.

Dec. 17—24th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

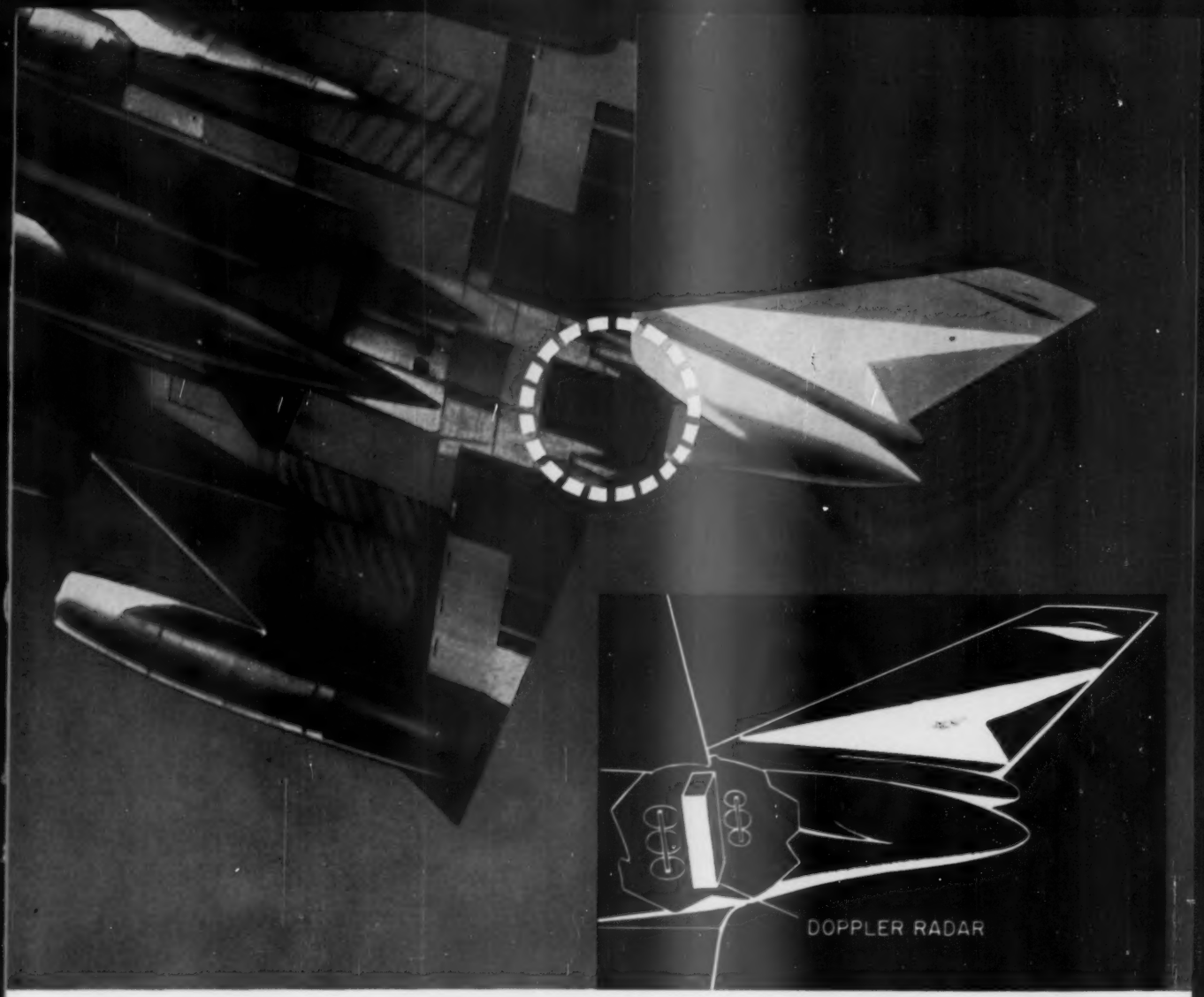
Dec. 26-31—127th Meeting, American Association for the Advancement of Science, New York, N. Y.

Dec. 28-30—Seventh King Orange International Model Plane Meet, Miami, Fla.

Jan. 9-11—Seventh National Symposium on Reliability and Quality Control, Bellevue-Strafford Hotel, Philadelphia, Pa.

Jan. 9-13—International Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.



Put a Doppler here? Raytheon did!

Located in the tail section of the Convair B-58 Hustler, Raytheon's Doppler radar is subject to all the following: transonic and supersonic shock waves, intense tail-pipe and skin friction heat, turbulence from the pod, extreme vibration and acoustic noise levels, and very high altitudes.

Despite this environment, Raytheon's Doppler radar meets SAC's stringent accuracy requirements. It is boresighted on the ground, eliminating in-flight calibration, and is a prime sensor to Sperry Gyroscope Company's Bomb-Navigation System.

This Doppler is designated AN/APN-113. It was designed, developed and produced by Raytheon to operate reliably under the severest environmental conditions encountered by any aircraft today. It is a dramatic demonstration of Raytheon's capability to overcome environmental barriers.

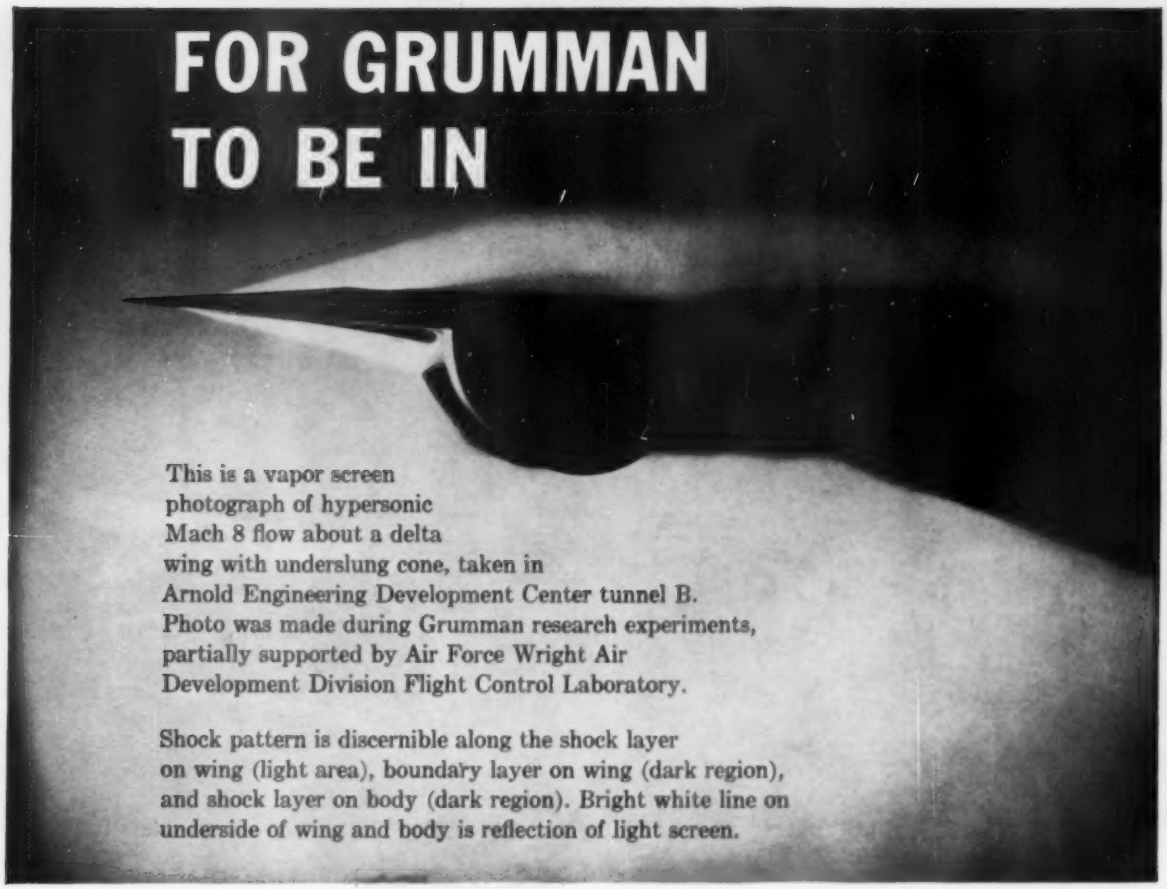
For New Airborne Operations Brochure Write:

DIRECTOR OF MARKETING,
Equipment Division,
Department K-1, Raytheon Company,
West Newton, Massachusetts

RAYTHEON EQUIPMENT DIVISION

EXCELLENCE IN ELECTRONICS

NOTHING IS TOO FAR OUT.... FOR GRUMMAN TO BE IN



This is a vapor screen photograph of hypersonic Mach 8 flow about a delta wing with underslung cone, taken in Arnold Engineering Development Center tunnel B. Photo was made during Grumman research experiments, partially supported by Air Force Wright Air Development Division Flight Control Laboratory.

Shock pattern is discernible along the shock layer on wing (light area), boundary layer on wing (dark region), and shock layer on body (dark region). Bright white line on underside of wing and body is reflection of light screen.

This photo characterizes the work Grumman is doing in hypersonic aerodynamics. Other efforts at Grumman include continuing design and development work on orbiting observatories, interplanetary communication systems, re-entry vehicles and reconnaissance satellites, to name a few.

Most important: Grumman has the "people capability" to transform advanced ideas to reality. So . . . if you have a problem that's far out . . . call Grumman in.

ADVANCED IDEAS GROW INTO REALITY AT

GRUMMAN

AIRCRAFT ENGINEERING CORPORATION

Bethpage · Long Island · New York

CRIMP at bench...or at equipment

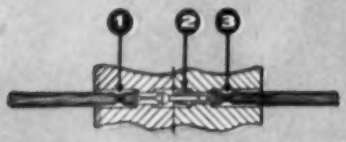
Precision hand, pneumatic, or automatic tooling guarantees uniform and complete crimp for each connection —a measurable quality control —at a high speed production rate.

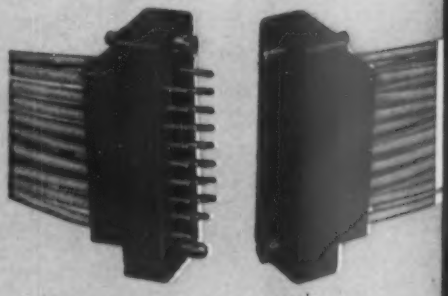
SNAP-LOCK ... in or out

Pins and sockets are easily and quickly snap-locked into plugs and receptacles. They may be removed with a simple extraction tool for circuit changes or checks.

CONNECT ... only 3 points of contact

The HYFEN method provides the minimum number of contacts—3—thereby reducing reliability problems. Exceeds the requirements of MIL-C-5015C and MIL-C-8384A.

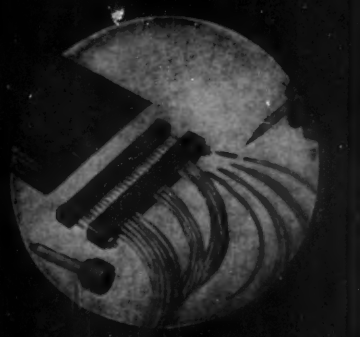




ACCEPTED! Hyfen Variations

ME face and panel HYFEN connector. 9 or 25 place configuration. One-piece shell and one-piece block. Also available for coaxial or shielded cable.

Feed-thru, modular-design, multiple insert connector. 35 contact inserts can be removed from frame for easy contact insertion or removal. 5 or 8 insert frames available.



Printed circuit connector in either 31 or 45 place configuration. Accommodates single wire or combinations of wire-sizes.

HYFEN types illustrated are typical of those already supplied to the industry by BURNDY. HYFEN connectors are engineered to meet specific requirements. For other types or sizes, contact BURNDY.

HYFEN® connectors

with crimp-type snap-locked contacts

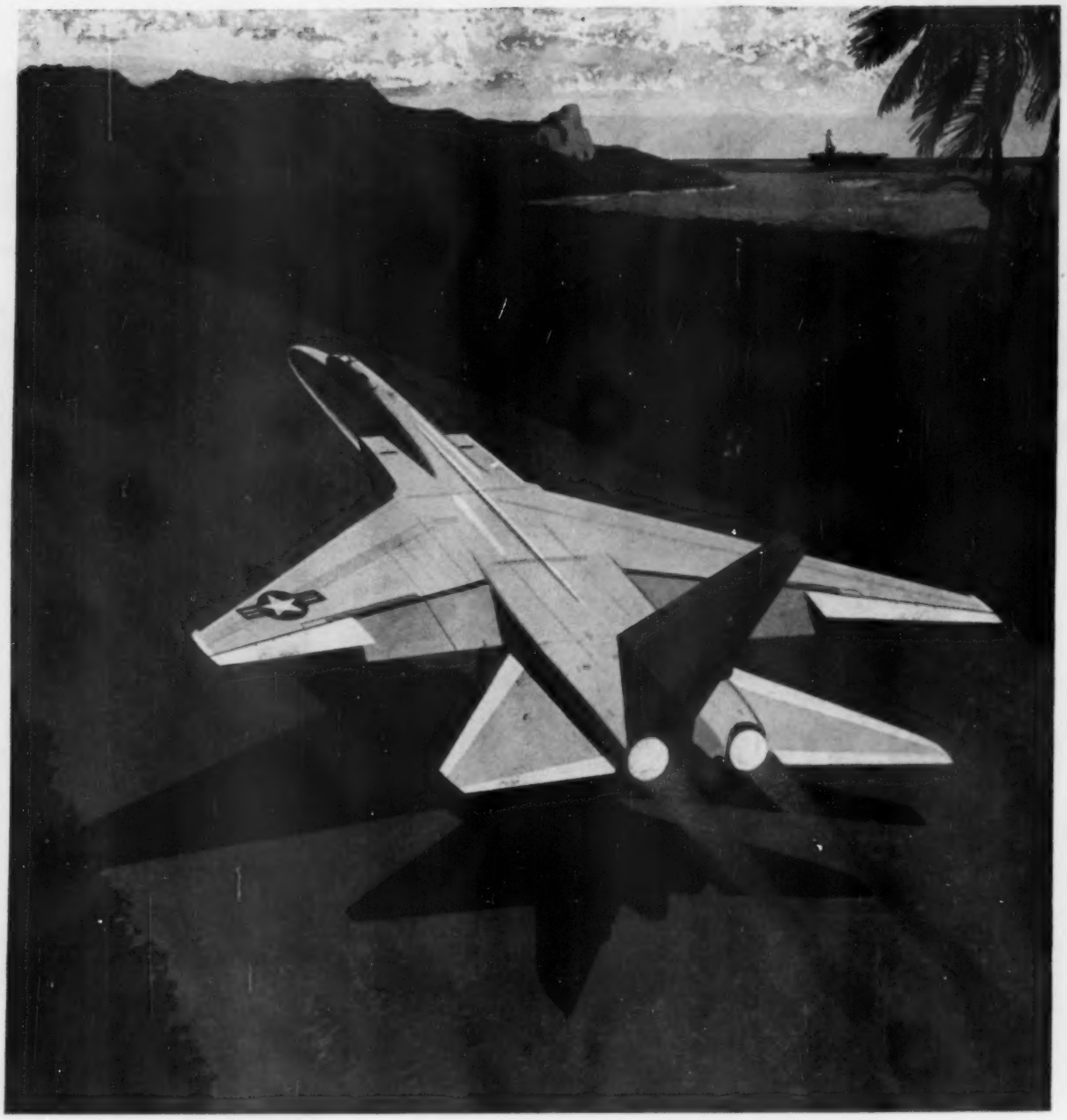
BURNDY's HYFEN method, already widely accepted in the industry, speeds the wiring of electronic harnesses and systems, and achieves greater dependability and versatility than has heretofore been possible. Crimp-type connections eliminate time-consuming solder operations and the disadvantages in the use of solder.

For complete information, write: OMATON DIVISION

BURNDY

59-3

Norwalk, Connect. In Europe: Antwerp, Belgium Toronto, Canada



Wherever it's needed, the Navy's A3J can go

Give the versatile A3J Vigilante a small runway ashore, or the deck of an aircraft carrier, and this compact hard-hitting airplane can go into action.

It can streak along the ground for deck-level penetration, or climb into the stratosphere to carry out high-level missions at Mach 2 speeds. It can intercept, attack, reconnoiter. Advanced control and delivery systems enable the A3J to perform its many missions in any weather, at any altitude or attitude. Built-in simplicity of maintenance and servicing makes it a truly practical airplane from every standpoint.

Equipped for a wide variety of tactical situations, the many-talented A3J Vigilante is an extremely valuable item in the nation's defense inventory. Designer and builder: the Columbus Division of North American Aviation.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, Ohio

Miniature Soldiers. Army ants carry out intricate maneuvers of wheeling, flanking, and envelopment with faultless precision. Their columns are led by "majors", preceded by "scouts". Raids are conducted by "skirmishers". Between campaigns, they form "bivouacs". Army ants are nature's tiny troopers.

Miniature Ball Resolver, approximately 3⅛" x 2½" O.D. continuously calculates position of aircraft and missiles traveling at supersonic speeds. MPB bearings at critical points keep torque low, and help make possible an accuracy of 0.33 of 1%. This is another man-made miracle in miniaturization.

Man with Miracle. This is Dick Anderson, one of MPB's Sales Engineers, whose cooperation with customers includes expert aid in the application of miniature and instrument bearings. MPB's technical staff, most experienced in its field, can assist you with your own miracles in miniaturization.

Miracles in Miniaturization

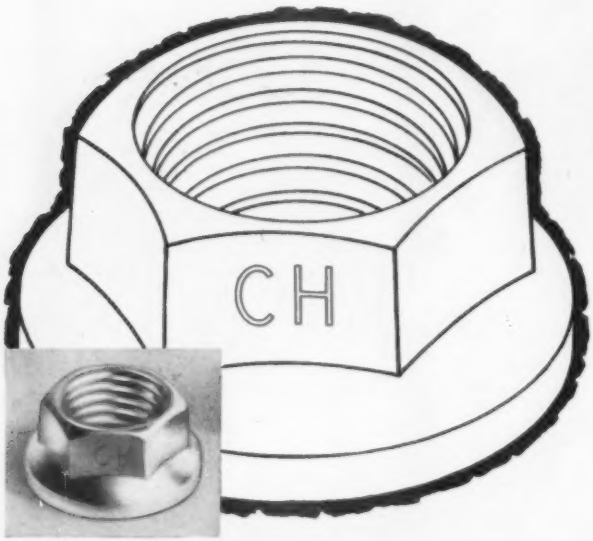
Actual Size of the MPB Bearings in Ball Resolver Shown Above

Every day man's advances, both on this planet and beyond, are opening new and challenging areas of application for miniature components and mechanisms. And at each step forward, MPB is ready to help with research, engineering and manufacturing facilities unsurpassed in the miniature bearing industry. MPB makes more than 500 types and sizes of bearings ranging from ⅛" O.D. down, meeting requirements of the most exacting nature. Specials developed on request. For a confab on design problems or our latest catalog write **Miniature Precision Bearings, Inc.,** 610 Precision Park, Keene, N. H.

MPB *Helps you perform miracles in miniaturization*

NOW! *the lightest locknut with*

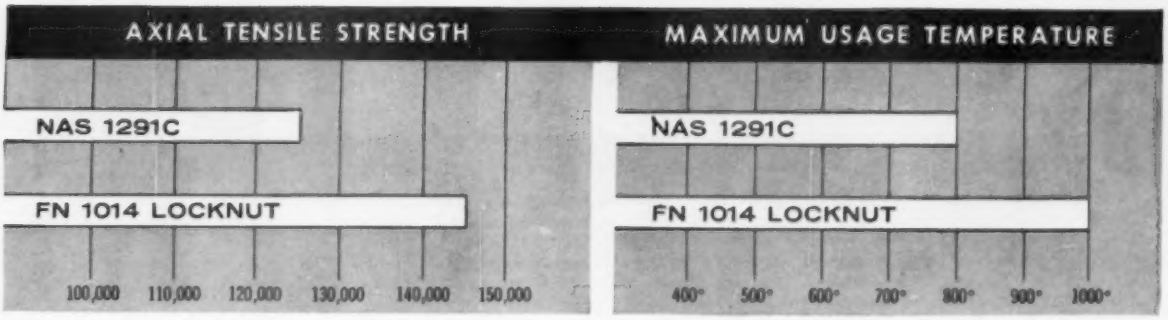
145,000 psi tensile strength, 1000°F maximum temperature



Lighter, yet stronger—that's a capsule description of SPS's new FN 1014 Featherweight Nut. Though weighing less than either NAS 679C or AN 363C Series nuts, the FN 1014 nevertheless has a tensile strength of 145,000 psi and a maximum usage temperature of 1000°F. Also extremely significant is the fact that the FN 1014 exceeds the NAS 1291C locknut standard, which requires 125,000 psi tensile strength and 800°F maximum usage temperature. You thus get that vital *extra* margin of safety which assures high reliability.

Further important features of the FN 1014:

- Silver plated finish provides excellent resistance to galling and seizing at temperatures to 1000°F
- Maximum magnetic permeability is 1.1 oersteds, compared with the NAS 1291C requirement of 2.0 oersteds
- Efficient design permits closer installation to perpendicular bulkheads, smaller and thinner flanges
- Wrenching strength exceeds values of NAS 1291C and Specifications MIL-N-25027 and MIL-N-7873
- Thread form is in accordance with MIL-S-7742, Class 3B
- Forged from A-286 heat and corrosion-resistant steel
- Meets proposed MS 21043



Designed for use at moderate temperatures is the FN 1014M Series, also made of A-286 material, but coated with an approved molybdenum disulfide dry film lubricant. Both FN 1014 and FN 1014M are available in sizes from #4-40 through ⅜"-24 from any SPS sales office or authorized aircraft fastener distributor.

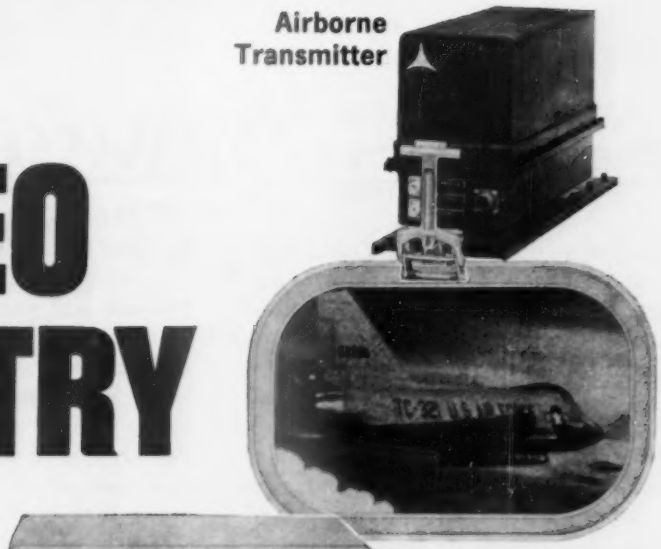
For more information, write STANDARD PRESSED STEEL—manufacturer of precision threaded fasteners and allied products in many metals, including titanium and beryllium. Request Bulletin 2686. AIRCRAFT/MISSILE Division, SPS, JENKINTOWN 3, PENNSYLVANIA • SANTA ANA, CALIFORNIA.

sps

where reliability replaces probability

Atlanta, Ga. • Dallas, Tex. • Tuckahoe, N.Y. • San Diego, Calif. • San Leandro, Calif. • Seattle, Wash. • Wichita, Kans.

TAPCO FM VIDEO TELEMETRY LINK



Monitored TV picture telemetered from F-104 chase plane by TAPCO system at the Air Force William Tell weapons meet.

Ground-based Receiver

TAPCO true FM video telemetry systems are built around an exclusive TAPCO circuit design. They utilize a unique system of signal synthesis which combines the advantages of wide-deviation FM modulation with the high-frequency stability of crystal-controlled equipment. The airborne transmitter is of compact modular design, allowing a wide choice of module components, and minimum problems of system integration.

APPLICATIONS

TAPCO video telemetry systems are ideal for applications requiring extremely stable picture transmission and reception. Operation over distances from one to 500 miles is not unusual. These systems are now ready for application to manned aircraft, drones, missiles, satellites, balloons, space stations, and tanks, trucks, and bulldozers operated remotely in nuclear or other hazardous environments.

PERFORMANCE

Video Band Width: Up to 10 megacycles.

Frequency Stability: Transmitter–0.01%.
Receiver–0.001%.

Power Output: From 1 to 30 watts.

Output Frequency: 800-900 megacycles.

COMPLETE SYSTEMS

TRW can provide complete or partial telemetry systems, including transmitters, receivers, antennas, and the video camera and terminal equipment. Considerable system flexibility is allowed by the wide range of component choices.

TAPCO GROUP EXPORT REPRESENTATIVE
American Avitron Inc., Mamaroneck, New York

Advanced engineering projects at TAPCO offer excellent career opportunities for qualified engineers and scientists. Write Supervisor of Salaried Personnel.

TRW

TAPCO GROUP
Thompson Ramo Wooldridge Inc.
DEPT. AW-1-1060, CLEVELAND 17, OHIO

DESIGNERS AND MANUFACTURERS FOR THE AIRCRAFT, MISSILE AND SPACE, ORDNANCE, ELECTRONIC AND NUCLEAR INDUSTRIES

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Thermal Stress-Relieving of Alloy Steels

In the production of alloy steel bars and parts made of alloy steel, stresses are sometimes set up, and these stresses must be relieved before optimum results can be expected. Two general types of stress-relieving are practiced—thermal and mechanical. In this discussion we shall consider only the former.

There are several important reasons for thermal stress-relieving. Among these are the following:

(1) The first and most fundamental purpose is to reduce residual stresses that might prove harmful in actual service. In the production of quenched and tempered alloy steel bars, machine-straightening is necessary. This induces residual stresses in varying degrees. Bars are usually stress-relieved after the straightening operation. When the bars are subjected to later processing that sets up additional stresses, subsequent stress-relieving may be necessary.

(2) A second major purpose of thermal stress-relieving is to improve the dimensional stability of parts requiring close tolerances. For example, in rough-machining, residual stresses are sometimes introduced, and these should be relieved if dimensional stability is to be assured during the finish-machining.

(3) Thermal stress-relieving is also recommended as a means of restoring mechanical properties (especially ductility) after certain types of cold-working. Moreover, it is required by the "safe-welding" grades of alloy steels after a welding operation has been completed.

Alloy bars are commonly stress-relieved in furnaces. Temperatures under the transformation range are employed, and they are usually in the area from 850 deg to 1200 deg F. The amount of time required in the furnace will vary, being influenced by grade of steel, magnitude of residual stresses caused by prior processing, and mass effect of steel being heated. After the bars have been removed from the furnace, they are allowed to cool in still air to room temperature.

In the case of quenched and tempered alloy bars, the stress-relieving temperature should be about 100 deg F less than the tempering temperature. Should the stress-relieving temperature exceed the tempering temperature, the mechanical properties will be altered.

Items other than bars (parts, for example) can be wholly or selectively stress-relieved. If the furnace method is used, the entire piece is of course subjected to the heat; selective relieving is impossible. However, if a liquid salt bath or induction heating is used, the piece can be given overall relief or selective relief, whichever is desired.

Detailed information about stress-relieving is available through Bethlehem's technical staff. And remember that we can furnish the entire range of AISI standard alloy steels, as well as all carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

The Avnet System

creates a new Concept of Scheduling

30 days hath September, April, June and November. All the rest have 31 except The Avnet System, whose calendar is the delight of engineers and electronic purchasing men all over America. Yes, there are 30 days in Avnet's November, but your order knows no weak-ends. Within the same 30 days, The Avnet System ships more orders than any other major source of supply. Your specific order therefore, can be scheduled for quicker delivery, faster use.

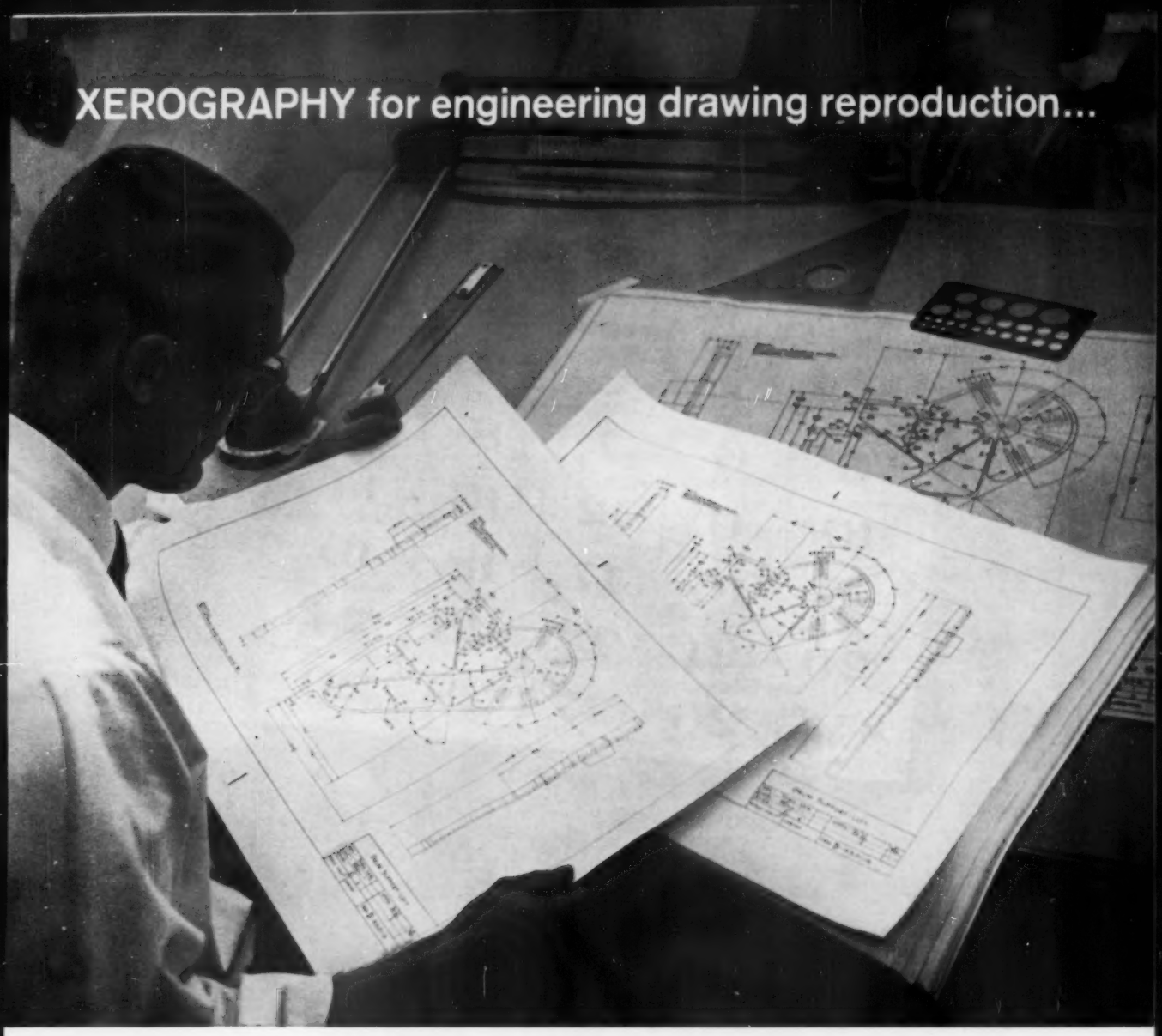
This new Concept of Scheduling according to customer convenience rather than calendar convenience is one of the many advantages in The Avnet System. *Avnet maintains a network of Sales Engineers traveling the U.S. Each engineer has his counterpart in a Service Center Expediter. Tremendous stocking facilities are maintained strategically throughout the country. Avnet maintains and operates complete assembly facilities for Connector Prototype requirements.* For the most expeditious Scheduling contact your nearest Service Center in The Avnet System.

AVNET

THE AVNET SYSTEM
Men / Methods / Materials / Management
AVNET ELECTRONICS CORP.

Avnet Service Centers and Stocking Facilities are located in Los Angeles, Cal.; Sunnyvale, Cal.; Chicago, Ill.; Dayton, Ohio; Westbury, L. I.; Burlington, Mass.

Avnet distributes from its stocking facilities: BENDIX SCINTILLA CONNECTORS, SPERRY SEMICONDUCTORS, RHEEM SEMICONDUCTORS, ELECTROSNAP AND HETHERINGTON SWITCHES, GREMAR CONNECTORS, CLARE RELAYS, ROBERTSON SPLICE & CONNECTOR CASES, BABCOCK RELAYS, HRNG SUBMINIATURE HI-TEMP CERAMIC CAPACITORS, TIC PRECISION TRIMMERS, VIBREX FASTENERS by GENERAL TIRE & RUBBER CO., U.S. SEMCOR SEMICONDUCTORS, SANGAMO CAPACITORS, SPRAGUE CAPACITORS



. . . gives you high-quality engineering prints in half the time, at remarkable savings!

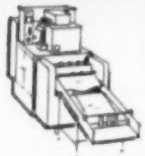
Xerography is the fast, clean, dry, electrostatic copying process that has revolutionized engineering drawing reproduction! Many of the nation's leading industrial firms now use Haloid Xerox copying equipment . . . with reported savings from $20,000 to $500,000 a year! And, all XeroX equipment is available to you, without capital investment, at modest monthly rentals.

For high quality offset paper masters:

XeroX® Model 1218 copying equipment combines with offset duplicating . . . and the results are spectacular! This equipment prepares sharp, inexpensive paper masters from original drawings of A to D size. The larger drawings are perfectly reduced to 12" x 18" masters, from which multiple prints can be run off in seconds!

Volume reproduction from original drawings or roll microfilm: Just push a button on the XeroX Copyflo® Continuous Printer for sharp, dry, ready-to-use prints (on ordinary paper, vellum or offset paper masters up to 11" wide). Prints are made at the rate of 20' a minute. Copyflo printers enlarge, reduce or copy size-to-size from original drawings or roll microfilm (16 or 35mm).

Reproduction from card-mounted microfilm: The XeroX Copyflo 24 C and the exciting new Copyflo 1824 automatically produce dry, positive prints on ordinary paper, vellum or offset paper masters from 35mm card-mounted microfilm! The Copyflo 24C produces ready-to-use prints (up to 24" x 36") at the rate of 20 linear feet a minute! The new low cost Copyflo 1824 for small volume users or large, decentralized users, produces prints from 8½" x 11" to 18" x 24".



GET ALL THE FACTS! Send for EDX Booklet today. Write: HALOID XEROX INC., 60-103X Haloid St., Rochester 3, N.Y. Branch offices in principal U.S. and Canadian cities. Overseas: Rank-Xerox Ltd., London.

HALOID XEROX

Cleaning of components for liquid oxygen and liquid hydrogen (and other fuels) often raises the question: "*How clean is clean?*" In the case of Flexonics metal hose,

ducting, and expansion joints for both in-flight propulsion systems and ground support, here is our answer: "Not just hygienically clean, but *cryogenically* clean!" Flexonics has developed a unique "liquid honing" cleaning system, which produces results that exceed the industry's highest standards. Specify Flexonics for ducting assemblies and other flexible components. For the perfection and reliability you need, place the whole responsibility under one roof!

Mail the coupon today for your copy of the big, instructive Flexonics catalog.

A-430

Flexonics
corporation

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ont.

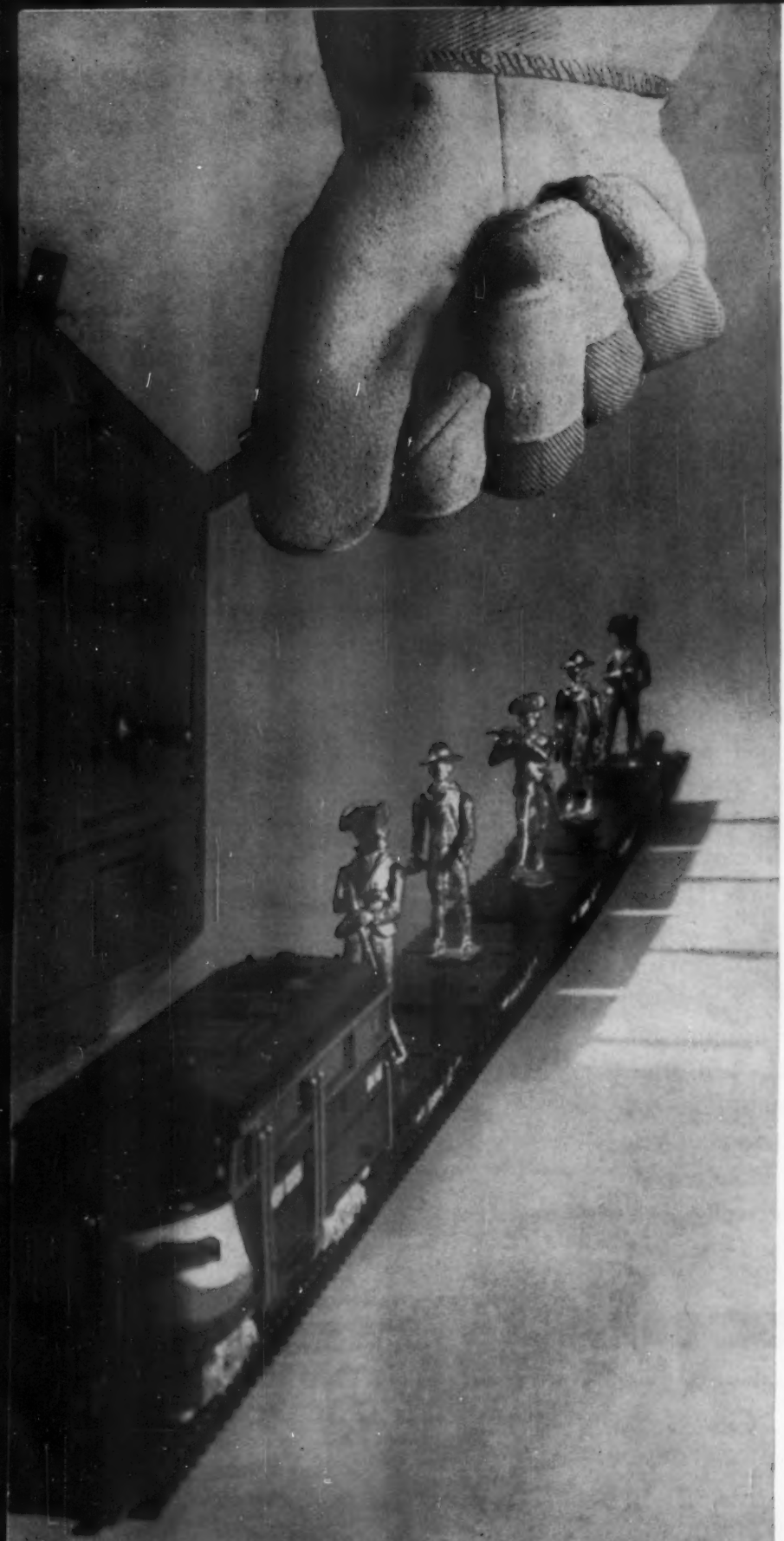
EXPANSION JOINTS | METAL HOSE | SYNTHETIC HOSE | BELLOWS | AERO/SPACE COMPONENTS

SUBSIDIARY OF CALUMET & HECLA, INC.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY

FLEXONICS CORPORATION
1315 S. Third Avenue, Maywood, Illinois

Please send me my personal copy of the big new Flexonics engineering guide and catalog of aero/space components.



He's got Minutemen "working on the railroad"

Hard basing is one way to protect America's force of retaliatory ICBM's. The problem was to find an alternate means of accomplishing the same mission. The Air Force solution was a new ICBM mobility concept—railroad car-mounted Minutemen, utilizing the nation's vast track mileage for numerical and geographical dispersion, creating a difficult target for enemy attack.

To put the Minuteman, its support systems and associated equipment on rails was a completely new problem in missile handling. The first requirement assigned by Boeing to American Machine & Foundry Company and ACF Industries, Inc., was a feasibility study of the existing limitations of roadbeds, rails, railroad operations and right-of-way. Unique tactical cars are being designed within these limitations to carry the Minuteman—cars that can handle the missile and its operating equipment, safely isolated from roadbed shock and ready for immediate retaliatory launching.

Single Command Concept

Whether for conceptual problems such as this one, or for challenges in design or manufacturing, AMF has ingenuity you can use. AMF people are organized in a single operational unit offering a wide range of engineering and production capability. Its purpose—to accept assignments at any stage from concept through development, to production, and service training...and to complete them faster in

- *Ground Support Equipment*
- *Weapon Systems*
- *Undersea Warfare*
- *Radar*
- *Automatic Handling & Processing*
- *Range Instrumentation*
- *Space Environment Equipment*
- *Nuclear Research & Development*

GOVERNMENT PRODUCTS GROUP,
AMF Building, 261 Madison Avenue,
New York 16, N. Y.

AMF

In engineering and manufacturing AMF has ingenuity you can use...

AMERICAN MACHINE & FOUNDRY COMPANY

October 10, 1960

Aviation Week and Space Technology

Vol. 73, No. 15
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630 Los Angeles 17—1125 West Sixth St., Phone: HUntley 2-5450 Dallas 1—1712 Commerce St., Phone: Riverside 7-9721 European Office—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63

PUBLISHER.....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....William Gregory
EUROPEAN EDITOR.....David A. Anderton
WASHINGTON.....Cecil Brownlow
NEW YORK.Harry Raven, Herbert J. Coleman, John A. Nammack
LOS ANGELES, Irving Stone, Russell Hawkes, William S. Reed
DALLAS.....Erwin J. Bulban
ENGINEERING.J. S. Butz, Jr., Michael Yeffee
AVIONICS.....Philip J. Klass, Barry Miller
CONGRESS.Ford Eastman, Katherine Johnsen
SPACE TECHNOLOGY.Evert Clark, Craig Lewis, Edward H. Kolcum
TRANSPORT.....L. L. Doty, Glenn Garrison, Robert H. Cook, David H. Hoffman
MILITARY.....Larry Booda
EQUIPMENT.....Barry Tully
BUSINESS FLYING.....Erwin J. Bulban
ART EDITOR.....Lawrence J. Herb
ASST. ART EDITOR.....Karl G. Neuman
SPECIAL PROJECTS.....Andrew A. Keil
EDITORIAL PRODUCTION....Arnold Sherman
ASSISTANT EDITORS.....Elizabeth M. Hein, Edith Walford
EDITORIAL ASSISTANTS.....Marjorie Nail, Jerome Bailey, Marjorie Todd
LIBRARIAN.....Theresa V. Maggio

FOREIGN NEWS SERVICE
EDITOR.....John Wilhelm
LONDON.....John Tunstall
PARIS.....Robert E. Farrell
MOSCOW.....Ernest Conine
MEXICO CITY.....Peter Weaver
TOKYO.....Sol Sanders

DOMESTIC NEWS BUREAUS
ATLANTA 3.....1301 Rhodes-Haverty Bldg.
CHICAGO 11.....520 No. Michigan Ave.
CLEVELAND 15...1164 Illuminating Building
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....W-724 Prudential Bldg.
SAN FRANCISCO 4.....68 Post St.

SALES
ADVERTISING SALES MANAGER E. P. Blanchard, Jr.
ATLANTA.....R. H. Powell
BOSTON.....A. C. Boughton
CHICAGO and ST. LOUIS.....J. S. Costello, D. C. Jackman
CLEVELAND.....T. H. Hunter, Jr.
DALLAS.....R. T. Wood
DENVER.....John G. Patten
DETROIT.....R. R. Butera
LOS ANGELES.....C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK.....M. J. Storz, J. M. Grinton, R. Wallace, J. D. Warth
PHILADELPHIA..J. D. Willis, J. M. Tannehill
PITTSBURGH.....G. R. Schaefer
SAN FRANCISCO.....William Woolston
PROMOTION & RESEARCH MGR..C. C. Gersna
EUROPEAN MARKETING DIRECTOR Fulvio Piovano
RESEARCH & MARKETING Rosalie Christesen, Jacqueline Gonnet

BUSINESS
BUSINESS MANAGER.....J. G. Johnson
CIRCULATION MANAGER.....T. J. Lucey
ASST. BUSINESS MANAGER...W. V. Cockran
PRODUCTION MANAGER.....F. A. Dube

Saturn, F-1 and Rover Studied for Nova..... 26
▶ NASA evaluating alternatives for next general vehicle; to set firm concept after systems are tested.

Fuel Injection Failures Grounded Il-18..... 37
▶ Quesada reports engine problem halted transport's operations; FAA chief calls Aeroflot operating facilities below standard.

USAF Evaluates Aircraft for Missile Site Support.. 88
▶ Helicopters, fixed wing aircraft compete for Strategic Air Command utilization; outcome may be mixed support fleet.

SPACE TECHNOLOGY
Saturn, F-1, Rover Studied for Nova. 26
Apollo Capsule Has Glide Capability.. 27
Soviet Space Flight Meeting..... 28
Courier Tests Space Communications. 29
New Technique on Next Echo..... 31
Greater Biosciences Effort Needed.. 33
Scout Will Launch Satellite Next.... 34
Oxygen Test Studied..... 55
Sputnik V Recovery..... 59
USAF's Blue Scout Jr. Tested..... 62
Mercury Landing System Tests..... 65

AERONAUTICAL ENGINEERING
Second World Speed Record by F4H.. 32
Missile Site Supports Aircraft..... 88
FAA Adopts Visual Glide Slope..... 97
First T.188 Flight Delayed..... 98
RAF Sprung Seat Platform System... 99
Production Briefing..... 97

AVIONICS
Army Communications Satellite..... 71
New Component Packaging Concept.. 73
Missile Tracking Data Speeded..... 81
Filter Center..... 81
New Avionic Products..... 85

FINANCIAL
BOAC, BEA Reports..... 103
Fiscal 1960 Defense Funds..... 108
New Offerings..... 110
AMC Contracts..... 127

AIR TRANSPORT
Fuel Injection Failures Grounded Il-18 37
Few Changes Foreseen in IATA Fares 39
MATS' Need for Turbofan Transports. 40
New Sabena Routes..... 40
Initial Capacity Restriction Drive Fails 42
CAB Urges Capital Merger Changes.. 42
Airport Area Land Use Problem..... 45
Politics Hampers Jet Airport..... 47
EAL's Enlarged Mexico City Service.. 47
World Market Sought for 749As..... 47
PanAm Seeks Stock Deadline Delay.. 49
ATA Probe Fight..... 49
Shortlines..... 52
Airline Observer..... 52

MANAGEMENT
GE Defense Facilities Escape Strike.. 28
Defense Frees More Extra Funds..... 30
Who's Where..... 23
Industry Observer..... 23
Washington Roundup..... 25
News Digest..... 34

BUSINESS FLYING
Executive Airport for Ft. Worth..... 115
Private Lines..... 118

SAFETY
Pilot Instrument Inexperience Cited. 119

Calendar..... 5
Letters..... 134

EDITORIAL
Where Do They Stand?..... 21

COVER: First launching of a Blue Scout rocket by the Air Force occurred last month when this Blue Scout Jr. vehicle was fired from Cape Canaveral, Fla. (AW Sept. 26, p. 29). The four-stage, solid-propellant rocket was intended to boost a 32.8-lb. payload to an approximate altitude of 16,600 mi. Telemetry contact with the vehicle was lost 8 sec. prior to burnout of the fourth stage engine. For other pictures see p. 62.

PICTURE CREDITS

Cover—USAF; 26—U. S. Army; 29—Wide World; 49—Boeing Airplane Co.; 55, 100—Pratt & Whitney; 57—Boeing; 62, 63, 88, 89—USAF; 65—Rocketdyne; 72—Delcon Corp.; 73—Autonetics Division; 94—General Electric; 98—Bristol Aircraft, Ltd.; 103—BOAC; 107—BEA; 116—Garrett Corp.

83,526 copies of this issue printed

The first six years of **S**pace **T**echnology **L**eadership

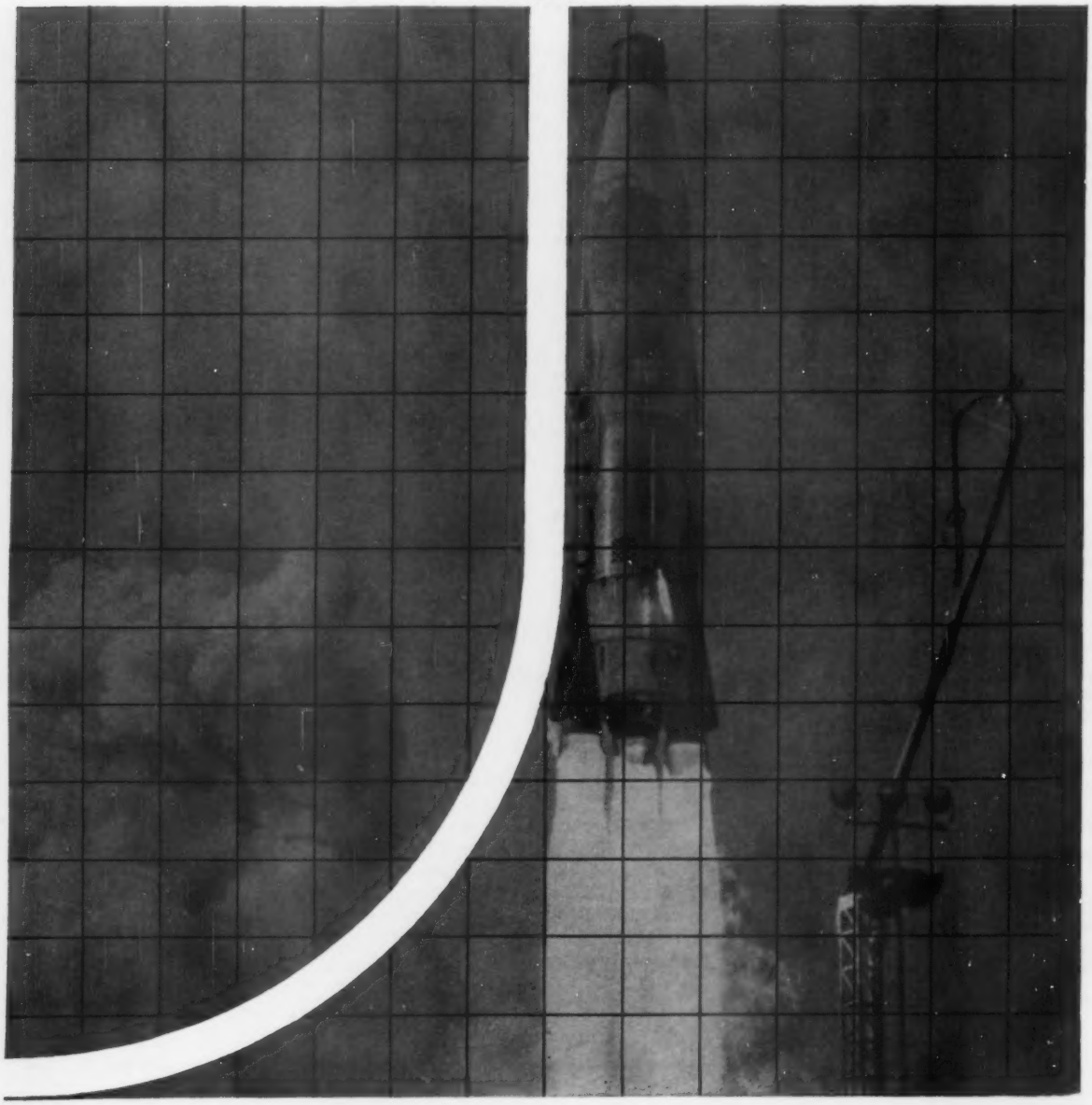
Since 1954, when the Air Force ballistic missile program was accorded top national priority, Space Technology Laboratories has been engaged in virtually every major phase of research, development, testing and technical management of missile and space systems • STL's contributions have hastened the day of operational capability for Air Force ballistic missiles, and have been applied as well in satellite projects and space probes • Today, as STL's activities expand in significance and scope, STL offers exceptional opportunity to the outstanding scientist and engineer whose talents and training will add to, and benefit from, the accumulated experience that has enabled STL to conceive and accomplish major advances in the state-of-the-art • STL's creative flexibility, anticipating and responding to the demands of space progress, ranges in application from abstract analysis to complex hardware fabrication for military and civilian space projects • STL invites scientists and engineers to consider career opportunities in the atmosphere of Space Technology Leadership. Resume and inquiries will receive meticulous attention.

SPACE TECHNOLOGY LABORATORIES, INC. P. O. BOX 95004, LOS ANGELES 45, CALIFORNIA

Los Angeles • Santa Maria • Edwards Rocket Base • Cheyenne

STL

Cape Canaveral • Manchester, England • Singapore • Hawaii



EDITORIAL

Where Do They Stand?

With only 30 days remaining until the presidential election, neither candidate for this high office has seen fit to expound his proposed policy on one of the most important issues governing the future of this country. This issue in its broadest sense is national defense and includes not only our formal military establishment but also the economic and foreign policies that combine with the military to weave the authentic fabric of national power and international influence. It certainly must include the critical area of space exploration and use for scientific, commercial and military purposes.

It is ironic that the defense issue has dropped completely from the campaign oratory repertoire of both presidential and vice presidential candidates. In the heat of the nominating conventions last summer both parties placed strong emphasis on the defense issue in their platforms. Vice President Nixon deemed it of sufficient importance to risk the displeasure of President Eisenhower to accept the stronger defense views of New York's Gov. Nelson Rockefeller. Similarly both parties picked vice presidential candidates who had outstanding records as advocates of stronger national defense.

As the campaign has progressed it has no doubt been encouraging for American citizens to learn that Vice President Nixon is irrevocably opposed to "dread diseases" and that Sen. Kennedy is against economic depressions. But we suspect they are even more concerned about what these two gentlemen and their cohorts plan to do about the sagging influence of the United States in the international scene and the failure to pursue a strong and vigorous national defense policy that fully exploits the technological revolution of the past decade. No amount of campaign oratory can gloss over the fact of this sagging prestige or the basic reasons therefore. Every newspaper reader or television viewer can see the results of this almost daily in the pounding of Nikita Khrushchev's fat fists on the United Nation's desks and the Hitlerian oratory of the big lie technique that the Soviet chairman has been spouting from the UN sounding board.

At the same time, the validity of defense criticism during the past year has been confirmed by the quiet actions of the Eisenhower Administration during the past month. As quietly as is possible in the goldfish bowl of Washington, this Administration has been sliding the additional defense funds voted by Congress into key development programs. These additional funds were bitterly denounced last summer by President Eisenhower as unnecessary and were promptly frozen by the Budget Bureau and Defense Department. The President further put himself on record against any increase in the defense program in his now famous "Job's boils" blast at his defense critics at the Republican convention in Chicago. As late as last August the Administration stood firm on freezing about $661 million of the additional funds voted by Congress (AW Aug. 15, p. 26).

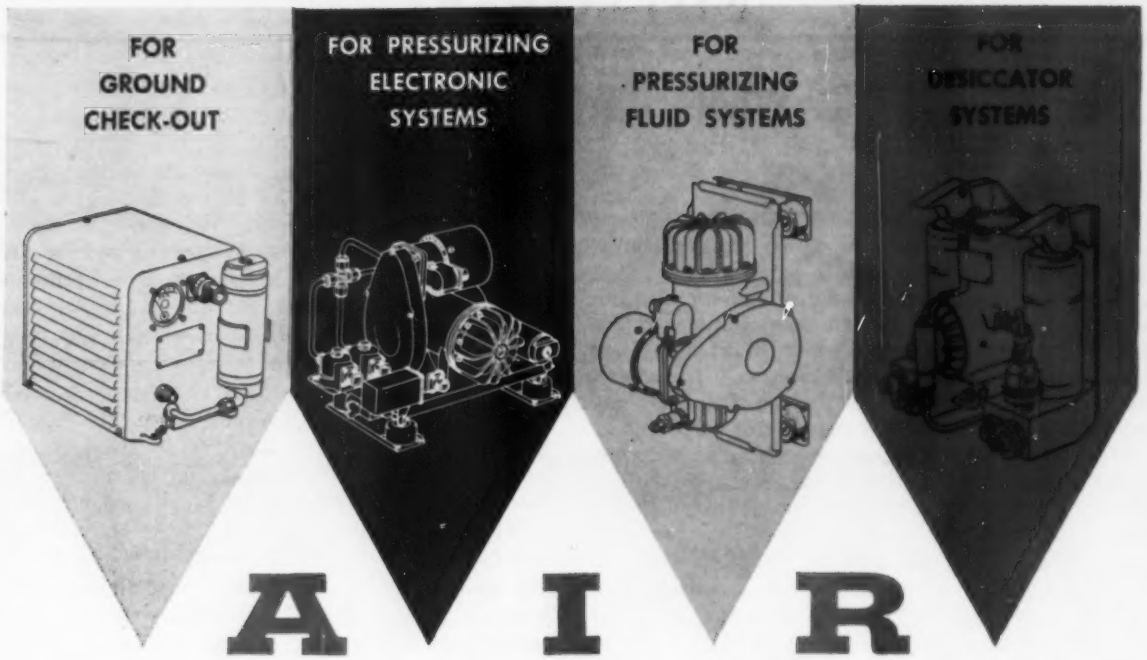
Now in the waning weeks of September and the early days of October this same Administration has been thawing out these frozen funds and quietly trickling them into the very programs that the critics have been howling about since last January as requiring more funding and higher priority. The roll call of the projects getting these additional funds (AW Aug. 8, p. 21; Sept. 26, p. 25; Oct. 10, p. 30) is the same as the key points hammered on by the defense critics for at least nine months—Polaris, Minuteman, Samos, Midas, B-70, MATS modernization, modernized Army equipment, anti-submarine warfare, Dyna-Soar, Skybolt and other key research areas. We certainly agree with Defense Secretary Thomas Gates' observation that the defense business can no longer be operated within the strictures of an annual budget procedure and must be subject to constant review and change to meet technical and political shifts and opportunities. But we think he also would agree with our observation that it is far better to conduct these reviews in advance of and in anticipation of events and policy shifts rather than far too long after the grim facts have become all too evident to the rest of the world.

Actually the defense critics of the Eisenhower Administration have been confirmed in almost every detail of their bill of indictment by the Administration's action in recent weeks. Particular credit should go to the military leaders who had the courage to voice their honest convictions before Congress last spring and to the congressional leaders who believed them and pressed resolutely for stronger emphasis and higher priority for key technical developments in the defense spectrum. In view of this notable victory, it is rather surprising to see one of its chief architects, Sen. Lyndon Johnson, the Democratic vice presidential candidate, miss the opportunity to emphasize the results of his work and the startling proof of the validity of his thesis.

We suspect that Messrs. Nixon and Lodge may be quietly waiting until this fiscal bookkeeping is completed in the Defense Department and then announce it with considerable fanfare as convincing proof that their party is not unmindful of defense requirements.

In any case, we believe the American voter will approach the polls with more positive convictions after both candidates express themselves clearly on the vital defense issue. It will indeed be a difficult choice of national leadership in the international crisis already upon us if neither sees fit to develop a vigorous policy and takes a firm stand in this area.

—Robert Hotz



AIR POWER

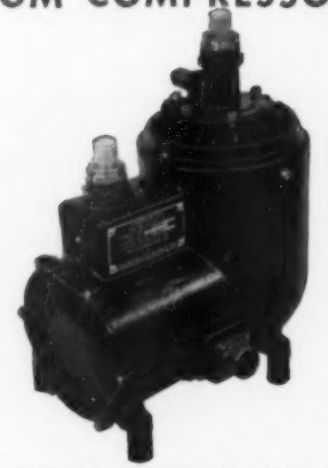
SUPPLIED BY CORNELIUS *oil free* DIAPHRAGM COMPRESSORS

When you need pneumatic pressurization packages for aero applications, it will pay you to check Cornelius equipment first. Cornelius Pressurization Packages offer advantages not found in any other equipment. These Cornelius systems feature purity of air and reliability. They also give you a system which is pre-engineered, pre-packaged and pre-qualified.

The No. 1 component of any pressurization package is the compressor. Cornelius systems incorporate Cornelius oil-free diaphragm compressors. These compressors are designed specifically for applications of this type. Because of their simple but dependable design, they help provide a system free from problems of friction, heat, lubrication, carbon dust and loss of capacity with wear.

Cornelius Pressurization Packages are available with either AC or DC motor and any combination of the following components: Gage or absolute pressure switch, gage or absolute pressure-vacuum relief valve, check valve, chemical dehydrator and warning light.

Cornelius Pressurization Packages and Diaphragm Compressors are currently being used on, or in conjunction with the Convair 880 and 600, Boeing B-52, Convair B-58, Lockheed RC-121, Fairchild C-123, Canadair CL-44 and Vickers-Armstrong Vanguard aircraft. For more information contact a Cornelius Sales Engineer or write for free literature.



MODEL 3650200 DIAPHRAGM COMPRESSOR — Provides 2 CFM of standard air at sea level (3456 cu. in.); 0-25 psig. output pressure. Weighs 10 lbs. with motor and measures 9⅜" x 7" x 11⅜" including motor. Designed for 1000 hrs. continuous duty operation in temperatures of −65° to +160° F.

Pioneers in Pressure Systems for Flight

THE Cornelius COMPANY / AERO DIVISION

554 - 39th Avenue N.E. • Minneapolis 21, Minnesota

Qualified individuals will find excellent opportunities available in Cornelius engineering and sales departments.

WHO'S WHERE

In the Front Office

Charles G. Gulledge, president and a director, California Eastern Aviation, Inc., Washington, D. C., succeeding **Martin T. Dyke,** resigned. Mr. Dyke continues as a consultant.

United Aircraft Corp., East Hartford, Conn., has appointed **Robert A. Aspinwall** a member of the corporation's operating and policy committee. Mr. Aspinwall is general manager of the Norden Division of UAC.

H. O. Bales, a vice president and director, Navan, a subsidiary of North American Aviation, Inc., Los Angeles, Calif.

Richard King, a vice president, Edo Corp., College Point, N. Y. Mr. King is president of Electric Indicator Co., Inc.

Harold W. Haynes, vice president-finance and controller, Boeing Airplane Co., Seattle, Wash.

John P. Day, vice president-engineering, Granger Associates, Palo Alto, Calif.

C. A. Chapman, vice president-sales, Lockheed Aircraft International, Los Angeles, Calif. Also: **C. A. Hofflund,** vice president-operations, and **F. A. Kanzler,** treasurer.

Henry C. Jones, executive vice president and director of operations, The Electrada Corp., Beverly Hills, Calif.

Rear Adm. Neil K. Dietrich (USN, ret.), a vice president, Hazeltine Corp., Little Neck, N. Y.

Allen F. Donovan, senior vice president-technical, Aerospace Corp., El Segundo, Calif. Also: **Jack H. Irving,** vice president-systems research and planning; **William W. Drake, Jr.,** vice president-administration; **Najeeb E. Halaby,** secretary-treasurer; **Edward J. Barlow,** vice president and general manager Engineering Division; **Dr. Chalmers W. Sherwin,** vice president and general manager, Laboratories Division.

Frank C. Bumb, Jr., vice president-engineering, American Concertone, Inc., Culver City, Calif., a division of Astro-Science Corp.

Russell E. Bowditch, vice president-marketing, Transval Electronics Corp., El Segundo, Calif.

Dr. Robert W. Hull, vice president in charge of reliability, Semiconductor Division, General Instrument Corp., New York.

James H. Brown, vice president-administration, Grand Central Rocket Co., Redlands, Calif.

Emory T. Nunneley, Jr., vice president and general counsel, Northwest Orient Airlines.

Joseph P. Gordon, vice president, Cathode Ray Tube Division, Electronic Tube Corp., Philadelphia, Pa.

Dale M. Nevitt, vice president-manufacturing, Western Design, division of U. S. Industries, Inc., Goleta, Calif.

Fred W. Wolcott, assistant director (tactical weapons), Office of the Director of Defense Research and Engineering, Department of Defense, Washington, D. C.

G. Ward Hobbs, director of the Federal Aviation Agency's Bureau of National Capital Airports.

(*Continued on page 113*)

INDUSTRY OBSERVER

► Vertol Division of Boeing has won an Army Transportation Research Command competition for a design study and preliminary design of a ground effect takeoff and landing vehicle (GTOL). General concept follows layout of model tested earlier at Princeton University's Forrestal Research Center (AW Dec. 7, 1959, p. 137). Other bidders included Convair, Grumman and North American.

► **General Electric and Avco are studying plasma engines for use with a 30-watt nuclear electric power system under USAF contracts.**

► Tactical Air Command will close bidding in December for the supersonic STOL fighter-bomber competition and expects to announce the winner next January. TAC is stressing two engines for reliability and a two-man crew because of complexity of managing electronic equipment. Designs probably will incorporate variable-sweep wings to achieve short takeoff and landing characteristics and reduce buffeting at supersonic speeds at sea level.

► **Winner of an Air Force Ballistic Missile Division study contract for a permanent satellite base and logistics support under Study Requirement 17532 is expected to be chosen before Nov. 1. This follows a lunar observatory study under SR 183 (AW Apr. 27, 1959, p. 26), on which no specific action has been taken.**

► USAF has shown continuing interest in NASA's Saturn space vehicle, and planned operational flight schedule of four per year could easily grow to 20 to 40 per year if both USAF and NASA order it.

► **Navy is anxious to see foreign sales of the McDonnell F4H interceptor to help write off high development costs, although the company is not pushing overseas sales. Latest Navy effort was recent demonstration of the aircraft for the chief of the Royal Australian Air Force at George AFB, Calif. USAF's Lockheed F-104B Starfighter also was demonstrated for RAAF.**

► North American Aviation is formulating a concept for a super Hound Dog air-to-ground missile in case Douglas Skybolt air-launched ballistic missile doesn't meet projected USAF schedule. Skybolt managers insist the project is proceeding according to the planned timetable.

► **Between 20 and 30 companies are expected to submit bids today to NASA's Marshall Space Flight Center for a single automatic checkout system to test all components, subassemblies and completed assemblies of the Saturn vehicle. NASA wants design to use existing hardware. Sixteen-month program will begin with a two-month study program to define specific system and will include design, fabrication and checkout phases, with funding at the satisfactory conclusion of each phase. Bidders will include Bendix, ITT, Nortronics, RCA and Stromberg-Carlson.**

► Omega BS-12D1 helicopter (AW Aug. 31, 1959, p. 120), powered by two 235-hp. Lycoming O-540 engines, has received its provisional type certificate from Federal Aviation Agency after seven weeks of test flying.

► **Navy's Atlantic Underwater Test and Evaluation Center will be extensively instrumented for anti-submarine warfare research, advanced torpedo testing sonar studies and other undersea warfare problems. Management of AUTEC, with its land sites on islands in the Grand Bahamas, will be Navy-run with technical assistance from industry.**

► Douglas Aircraft Co. has a USAF contract to study materials and processes in conjunction with handling and use of liquid hydrogen. Work is being done at Douglas' Sacramento, Calif., facility, and probably is related to Douglas' work on the S-IV stage of the NASA Saturn vehicle.

► **Proposals for airborne and ground communications schemes for USAF's Dyna-Soar boost glider are being submitted this month to Boeing, which is prime contractor for the glider portion of the system.**

WHAT'S BEHIND A BMEWS RADAR?

Years of experience—for as early as 1954, General Electric had conceived and developed radar equipment capable of detecting ballistic missiles at 1,000 miles. This was the forerunner of the AN/FPS-50 surveillance radar being provided by General Electric under subcontract to RCA for the Air Force Ballistic Missile Early Warning System (BMEWS).

The AN/FPS-50 radar equipment, with a range in excess of 2,000 miles, is a singular example of achievement in defense electronics. It is another milestone in General Electric's sustained engineering effort to develop and produce equipment to meet the unprecedented detection problems posed by ICBM's. 176-01

Progress Is Our Most Important Product

GENERAL ELECTRIC

DEFENSE ELECTRONICS DIVISION
HEAVY MILITARY ELECTRONICS DEPARTMENT
SYRACUSE, NEW YORK

Washington Roundup

Defense Budget Outlook

Eisenhower Administration is sticking close to the current defense spending level of about $40.2 billion in preparing the Fiscal 1962 budget. New money requests generally run about the same as expenditures. So the military budget the White House will send to Congress just before the President leaves office will be practically the same as the final version of the current budget—which includes the additions Congress made.

Military services were told to submit three budget proposals in their initial "budget exercises." One would hold the line at the current spending level, the second would be 5% higher and the third would be 5% lower. The services also have been asked for a priority list of proposed additions to the budgets they submit.

House Armed Services Committee staff reports little Pentagon cooperation in drafting legislation authorizing aircraft and missile procurement. Fiscal 1962 budget is the first in which the Defense Department will have to ask Congress for procurement authorization as well as appropriations. This gives the armed services committees a review of programs along with appropriations committees.

Defense Department opposed this new approach, which was dictated by Congress last year. It means two rounds of budget hearings on Capitol Hill. And a specific authorization law will reduce Pentagon flexibility in shifting funds from one program to another.

Key questions to be answered in this new process: Should programs be authorized in terms of numbers, categories or dollars? Will the services need authorization to buy substantial quantities of aircraft and missiles for development, test and evaluation programs? How can Congress permit Defense to make desirable procurement changes after the authorization law is passed without giving the department a blank check?

There is some suspicion in Congress that the Defense Department is switching programs from the procurement category to research, development, test and evaluation in hope of evading the new requirement for authorization.

Nuclear Tests Wanted

Atomic Energy Commission is eager to get back to nuclear testing in view of discouraging results from test ban negotiations. Returning last week from an International Atomic Agency meeting in Vienna, AEC Chairman John A. McCone warned of the dangers of allowing negotiations to frustrate weapons testing for too long. He agreed with Sen. Hubert Humphrey's approach of setting a deadline. Sen. Humphrey suggested June, 1961.

McCone sees no reason why the U. S. shouldn't go ahead with a series of small underground explosions, even while negotiations continue. He said such a program would improve the science of seismology and show how detection and identification systems can be improved. McCone pointed out that there is no way of knowing whether the Soviets are testing underground right now. AEC is ready to launch an underground test effort on a few weeks' notice.

Crux of the U. S. debate over testing is the eagerness of AEC and the services to actually demonstrate breakthroughs in small nuclear weapon yields. Substantial gains have been made, making a reality of the nuclear weapon small enough to fit in a briefcase. Past experience with large weapons makes AEC reasonably sure the small weapons will work, but they have never actually been tested.

Trans World Airlines remains in a state of suspension following an indecisive series of board of directors' meetings. The airline continues to operate without a president, and chances are strong that no president will be named until the financial picture clears. Fred M. Glass is still the leading candidate. Main block in the financing program seems to be Howard Hughes' reluctance to concede the control financiers want over TWA in return for their money. Board is recessed subject to immediate recall.

British comment continues to run against the decision to scrap the Blue Streak ballistic missile and buy the Skybolt from the U. S. Many elements of the press and Parliament still believe it was a mistake to trade an actual hardware program for what they consider to be still a paper design.

Efforts by the Air Force and Douglas Aircraft, Skybolt's developer, to counter this feeling have included a visit to the Douglas plant by a group of British aviation writers. So far these efforts have accomplished little. Adverse reaction to the project has caused so much concern that the problem is getting the personal attention of ARDC commander Lt. Gen. Bernard A. Schriever.

NASA's Plans Change

NASA's program for unmanned circumlunar flight with return to earth will be delayed beyond the original 1964 target so it can become part of the new Project Apollo. Only other official change so far in the 10-year program presented to Congress last January is an acceleration last spring in the Saturn booster program. Big unofficial change in the program is the slipping Project Mercury schedule, with the manned Redstone flight now out of the question for 1960. —Washington Staff

Saturn, F-1 and Rover Studied for Nova

NASA evaluating alternatives for next generation vehicle; to set firm concept after systems are tested.

By Edward H. Kolcum

Washington—National Aeronautics and Space Administration is intensifying studies to determine whether Nova, the next generation space vehicle, will be based on Saturn, clustered F-1 engine or a nuclear-powered first stage.

Nova is expected to boost manned spacecraft to lunar landings and on interplanetary flights. Although final decision on the Nova configuration is not expected for at least two years, NASA hopes to establish a firm concept as quickly as alternate systems can be evaluated.

Dr. Homer J. Stewart, director of NASA Program Planning and Evaluation, told AVIATION WEEK these developments will contribute to the Nova decision:

- **Performance tests** of the single-chamber-1.5 million lb. Rocketdyne F-1 engine.
- **Performance** of the Project Rover reactor in-flight test system.
- **Evaluation of Saturn** capability to rendezvous at an earth-orbiting space station where a planetary vehicle could be assembled for escape trajectories. This rendezvous system would require multiple launches of the advanced Saturn C-2 vehicle.

Long-range manned exploration program will draw heavily on the ambitious cosmology research program which NASA will undertake over the next decade, using unmanned spacecraft. Lunar program calls for a moon orbiter before the end of this year, and a Ranger impact next year. Utilization of Surveyor and Prospector craft in soft lunar landings are scheduled after 1963 (AW Aug. 1, p. 34).

Unmanned planetary exploration is scheduled to begin next year with close approaches to Venus and Mars by Mariner spacecraft. Program calls for a Voyager payload to orbit and land on these planets in five years, and is aimed at studying lunar, solar and planetary physics, biosciences, and development of instrumentation for eventual manned flights.

Other factors expected to affect the Nova design are cost, since an extensive program could cost over $1 billion annually, making it one of the most expensive projects ever undertaken by the U. S.; development of large solid boosters (AW Sept. 19, p. 28); and continuing in-house and contracted theoretical studies.

Evaluation Requirements

Dr. Stewart said a good F-1 evaluation can be made from ground tests, but assessment of a nuclear-powered first stage without flying it is questionable.

Lockheed Aircraft Corp. and Martin Co. are conducting theoretical studies for NASA of the over-all requirements for a nuclear flight test program, one phase of which is examining the nuclear booster as a ground-launched first stage.

In conjunction with the Atomic Energy Commission, NASA is looking into the over-all technology of nuclear propulsion since nuclear energy has the potential to deliver seven to 10 times the payload of chemical systems. Research in high energy systems is aimed at evaluating nuclear boosters. Low energy research is being done in the Snap program, which is expected to produce auxiliary power and spacecraft propulsion units.

Marshall Space Flight Center recently began an across-the-board package study of the F-1, including feasibility of the single-chamber concept and its comparison with the uprated Saturn.

Marshall study is expected to make full use of a recent study by H. H. Koelle of the center's Future Projects Office on the optimum size of orbital carrier vehicles.

Koelle concludes that in the large booster classes (one, three and 10 million lb. takeoff weights) the most economical approach would be launching of a large number of the smaller vehicles, while the best operational approach calls for a small number of the biggest vehicles.

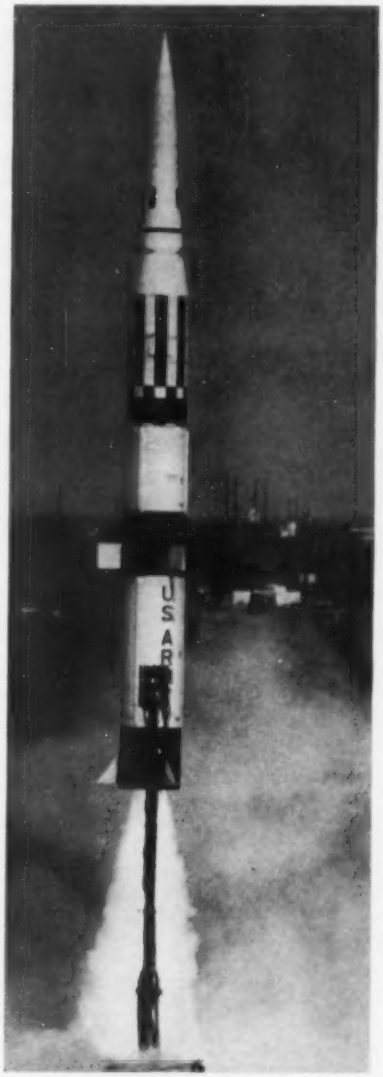
The Marshall scientist gave a "compromise" rule of thumb for determining the optimum vehicle size, which would be equal to the annual payload. For example, if Nova were to take the rendezvous approach and the annual amount of payload to be delivered to a 96 min. (307 naut. mi.) orbit was 1 million lb., Saturn would be the most desirable carrier size.

Size of the most desirable vehicle will increase with increased operational lifetime, Koelle said.

In arriving at his conclusions, Koelle

Belgian F-104 Order

Brussels—U. S. has agreed to underwrite financing of 25 Lockheed F-104G interceptors for the Belgian air force, boosting the total number of aircraft on order to the 100 originally planned by the Belgians, who will carry the cost of 75 (AW Sept. 26, p. 34). Mutual aid agreement was reached in negotiations here earlier this month between Belgian and U. S. officials. Stung by the economic impact of the loss of the Congo and by U. S. support of the United Nations move into the area, the Belgians at one time last summer had threatened to cancel all F-104 production plans.



Two-Stage Pershing

Army-Martin Pershing tactical range missile uses sharp nose for two-stage tests from Cape Canaveral, Fla. (AW Oct. 3, p. 38).

Anti-Missile Studies

Washington—Army Rocket and Guided Missile Agency is expected to award six contracts this week for feasibility studies of weapons systems designed to detect and destroy tactical ballistic missiles of the Pershing type.

Leading contenders for the $250,000 contracts are believed to be Convair, General Electric, Raytheon, Sperry, Martin and Sylvania. Contractors will be chosen from among 105 groups ARGMA asked for proposals, and they will make complete systems studies. Concurrent contracts for the nine-month program will be given Army arsenals for supporting research on subsystems and components as part of Army's program to develop in-house capability.

ARGMA will analyze plans for the final weapon system, taking the best elements of all studies, then development contracts will be awarded to several companies. ARGMA will act as system prime contractor.

made these operational and cost assumptions for 1966:

- **One million pounds of cargo** and equipment will support two 10-man space stations and a 50-man space station for a year, each man having a two-month duty tour.
- **Four million pounds of cargo** and equipment will support a 10-man lunar observatory for a year, with return of the first crew after six months.
- **Reliability will** have been established in 1966 by 25 accumulated flights of the Saturn, nine flights of the advanced Saturn and one flight of a 10 million lb. vehicle, which is the approximate weight of a launch vehicle using a clustered F-1 booster.
- **Vehicles will** be operated over a five-year lifetime.
- **Computations included** development of formulas to arrive at cost of production, development, transportation, launch, range, facility and ground support, and propellants for each vehicle.

Koelle detailed an over-all program for launching 3 million lb. per year over a five-year period, with the conclusion that the million pound takeoff weight is the most economical. A million pound vehicle program would cost $6.494 billion; 3 million lb. program would total $7.974 billion, and 10 million lb. booster program would cost $9.868 billion, Koelle said.

He added that if the operating period were extended to 10 years, larger vehicles become more economical because the high development cost can be distributed over more flight vehicles. If transportation volume exceeds 5 million lb. per year, he said, larger vehicles become more attractive because of a considerable reduction in the number of the launch complexes required.

For a 3 million lb. annual transportation volume, Saturn booster would require nine pads (34.6 days of pad time to prepare for each launch); 3 million lb. booster would require six pads (60.7 days per launch), and 10 million lb. booster requires four pads (114 days per launch).

Advanced Saturn configuration, with a maximum of 2-3 million lb. thrust, is considered at the least an interim vehicle, with the potential to accomplish early lunar exploration by means of orbital refueling.

Dr. Wernher von Braun, Marshall director, said a launch directly into a flight path away from earth is less complex and may be cheaper, but would come later since it depends on a liftoff thrust of 12 million lb.

Nova will be the fifth generation U.S. space vehicle, following the fourth-generation Saturn. First generation Jupiter Cs and Vanguards, have been phased out of use. Now boosting payloads in the second generation are Juno II, Thor-Able and Able Star, Atlas-Able, Thor-Agena A and Delta. Third generation will include Scout, Thor-Agena B, Atlas-Agena B and Centaur.

Apollo Capsule May Have Glide Capability

Santa Monica, Calif.—Apollo three-man capsule for lunar orbits and other space missions will probably have some aerodynamic glide capability to ease the re-entry heating problem, Dr. Wernher von Braun of NASA Marshall Space Flight Center told the Douglas Aircraft Co. management club here.

Apollo is one of the more advanced payloads planned for the Saturn space booster system and was planned as a blunt-nosed, symmetrical re-entry body similar to the Mercury capsule which has no aerodynamic glide capability.

Von Braun told the Douglas management club that after Saturn the aircraft industry must put space exploration on a more economical footing. He said he hoped to see the cost of space flight reduced to $1 per pound of payload in orbit. He predicted that Saturn C-1 would be "the last brute force effort to conquer space" and called it a crash effort to match the Russian ability to lift heavy payloads. He said gain will be weighted against cost more carefully in the future.

Von Braun cited re-usable boosters as one important cost-cutting device. NASA has been working on a recovery system for the first stage of the Saturn booster, but von Braun said the first two vehicles will be launched without it. He said the contractor for the system has slipped behind schedule and NASA cannot afford to pay for an intensive effort to catch up. The heart of the recovery system is a drag balloon of heat resistant plastic which decelerates the falling booster to Mach 7. At that point a reefed parachute is deployed and gradually opened to continue the deceleration. The low average density of the empty booster tanks makes rapid deceleration feasible and low atmospheric density at extreme altitudes limits aerodynamic heating at the high initial Mach numbers.

Von Braun called the staging ratio of Saturn C-1 "far from ideal." He said the two upper stages are too light for the power available in the first stage. He said the decision to go ahead with the early three-stage C-1 was made because of unexpectedly rapid progress in the development of the 17,500-lb.-thrust Centaur hydrogen-fueled engine by Pratt & Whitney and the lack of anything else which can orbit a 20,000 lb. payload. It was originally planned to wait for the four-stage C-2 with a more nearly optimum staging ratio.

Von Braun said NASA is giving serious study to the possibility of launching Saturn and the projected Nova system from offshore Texas towers. No more than two Saturns a month can be fired from land bases because of damage to the pad and other installations. He said the 250-ft.-tall Saturn service tower will be completely erected at Cape Canaveral around the end of this month.

Apollo Bids

Washington—Three companies will be selected in mid-November from approximately 25 proposing to National Aeronautics and Space Administration on Apollo capsule, for concurrent $250,000 studies to end in May, 1961. Despite the edge which this study contract may afford to each of the three companies, bidding for the capsule prime contract will be opened by next July for all of industry to compete. Purpose of this procedure is to encourage industry in general to initiate company-funded studies to be in competitive position.

Capsule is envisioned as accommodating three men for three-week duration in space. Launch is tentatively targeted for 1968.

Soviet Record Claim

Moscow—Soviet Russia has claimed a new nonstop world's distance record for helicopters. Fedor Belushkin reportedly flew a single-rotor Mil Mi-1 from Moscow to Krasnodar, a distance of 1,200 km. (745 mi.), in 7 hr. 40 min. Previous record, set by Belushkin in 1958, was 794.918 km.

Major GE Defense Facilities Escape Impact of IUE Strike

Washington—Some major General Electric defense plants escaped the impact of the International Union of Electrical Workers strike against the company last week, either because they have no union or have signed contracts with other AFL-CIO unions.

The IUE did affect GE's Pittsfield, Mass. plant, where the Ordnance Dept. produces inertial platforms for Polaris missiles and fire control systems for Polaris submarines. The union also struck at GE's Syracuse plant, where Heavy Military Electronics Dept. produces large radars and air defense systems.

At GE's large jet engine and rocket engine plant in Evendale, Ohio, the United Auto Workers (UAW and International Association of Machinists (IAM) locals both voted to accept the company offer of a three-year contract with an immediate 3% increase and another 4% pay hike in 18 months.

The IAM also accepted the company offer at GE's Light Military Electronics Dept. in Utica and Johnson City, N. Y. Missile and Space Vehicle Dept. in Philadelphia has no union.

The IUE, a member of the AFL-CIO, is bargaining agent for about 70% of GE's 100,000 factory workers. Union says that less than 10% of company's factory workers are in unions which have accepted the company offer.

Company will try to keep struck plants operating and is encouraging personnel to return to work. This is marked reversal of company policy during its last major strike in 1946 when it instructed white collared and supervisory personnel not to attempt to come to work, except under special situations.

Company's decision stems from results of pre-strike vote by IUE locals which showed a majority of union members voting wanted to accept the company offer. Decision to strike was made by union's GE Conference Board, where each of 58 bargaining units has a single vote regardless of the number of members it represents.

At GE's large Syracuse plant, which employs about 4,500 factory workers, company says that 800 reported for work the first day, 1,000 the second and 1,050 the third day. At Pittsfield, about 14% of the factory force was reported at work during first three days. At a small plant in Burlington, Vt., which produces missile nose cones, 622 out of a total of 707 factory workers reported the first day, GE said.

The IUE claims company figures are grossly exaggerated. It says that less than 1,000 factory workers reported the first day at all IUE plants, not counting Schenectady, N. Y. Here the union's largest GE local, which had voted against a strike, did not initially follow strike authorization of the IUE Conference Board. By mid-week, a petition had been circulated in the shops calling for support of headquarters action, and the local walked out.

Union Demands

The union's demands in closing pre-strike negotiation sessions were not too far from company's offer. The union wanted a two-year contract with a 3½% increase each year, for a total of 7% after 12 months, compared with total of 7% employes would have received after 18 months under the company offer.

Union also objected strongly to the company's decision to drop the cost-of-living wage escalator which had been in effect for the past five years.

Some observers believe the strike stemmed primarily from a long-standing feud between IUE President James B. Carey and top GE management over management's tougher policies for negotiating contract terms. Company reportedly has sought to establish the principle that its initial offer, made after extensive study, represents essentially its best offer and is not subject to "market place haggling."

Union and company met with federal mediators on the second day of the strike, but the two-hour session broke up with no progress. Union chief Carey announced that "not one single toaster or Polaris missile will be forthcoming without a contract." Another session with federal mediators was scheduled for later in the week.

Mounting disorders and violence on the picket lines of major plants at Syracuse, Pittsfield, Philadelphia (switchgear plant), and Lynn, Mass., as factory and white-collar workers sought entry, prompted GE to seek court injunctions calling for orderly picketing.

George Meany, president of AFL-CIO, was to confer with the presidents of major unions late last week to discuss a program for support of the IUE strike.

Although some observers see the reported back-to-work movement as an indication of a speedy settlement, others speculate that its potential threat to Carey's leadership will spark a long and possibly violent strike.

Strike Effect on Polaris

Washington—Strike of the International Union of Electrical Workers at General Electric's Ordnance Dept. in Pittsfield, Mass., is not expected to delay deployment of any Polaris submarines scheduled to go on station this year, Navy spokesman told Aviation Week. Navy declines to comment on possible effects on next year's schedules. Hughes Aircraft and Minneapolis-Honeywell, recently set up as second source with GE's Ordnance Dept. for the Polaris missile inertial guidance system, already have begun to make deliveries. However, there is no second source with GE's Ordnance Dept. for missile fire control systems installed in Polaris submarines.

Soviets Report On Space Flight Studies

Moscow—Studies so far fail to detect any genetic changes in bacteria recovered from the second Soviet space vehicle (AW Sept. 19, p. 73), according to Soviet academician Norair Sisakyan, speaking at a special meeting of the Soviet Academy of Sciences. As a protection of organisms against harmful vibration, Sisakyan indicated that suitable shock absorbers now are available. Discussing the future of manned space flight, he said space vehicles will have an insulated sealed cabin where atmosphere and temperature favorable for humans and organisms can be artificially maintained. Pressure in the capsule must fluctuate between 760 and 450 mm. of mercury with partial oxygen pressure of nearly 160 mm., which corresponds to approximately 20-40% of oxygen content. Carbon dioxide content of the capsule should not exceed 1%.

As for the problem of recovery of a manned space vehicle, Sisakyan contended that the Soviet Union has long been successfully carrying out a program of safe retrieval of animals and equipment from space. Sisakyan said biological experiment on the second vehicle showed temporary increases in alpha-globuline and total protein, as well as a reduction of cholinesterase activity in the two dogs, Belka and Strelka.

Academician Leonid Sedov said that while he is confident manned space vehicles will make interplanetary voyages, "it should be emphasized, however, that in the coming decade basic means of studying cosmic space around the moon and other planets will be by automatic space laboratories controlled by radio from the earth." Concerning flights to Venus and Mars, he pointed out, "to make these flights, new difficulties will have to be overcome. In particular, it will be necessary to ensure still more accurate operation of mechanisms."

Army Courier Tests Space Communications

Washington—Army Signal Corps plans an extensive program to fully develop active-repeater communication satellite operational techniques during the expected one-year life of Courier IB, which was launched into orbit last week.

The 500-lb. delayed repeater satellite was launched Oct. 4 by the Air Force from Atlantic Missile Range with a Thor Able-Star vehicle. It was injected into an orbit with a 752 naut. mi. apogee, somewhat lower than the desired 1,050 naut. mi. but still within acceptable limits. The 602 naut. mi. perigee is well within the desired 500-650 naut. mi. limits. Orbital period is 106.9 min.

Courier IB payload is identical to the 51-in. diameter package (AW Aug. 29, p. 72) of the Courier IA launch attempt which failed Aug. 18. It contains about 300 lb. of avionics equipment, including five transmitter-receiver-storage elements, FM and VHF telemetry transmitters, telemetry generator, VHF diplexer and command encoder.

Initial operational test was made on the second orbital pass when a voice message from President Eisenhower to Secretary of State Christian Herter was beamed from Ft. Monmouth's Deal station to Courier, then relayed to the Courier ground station at Salinas, Puerto Rico. It was then relayed by radio from Puerto Rico to Herter at the United Nations in New York.

After the Eisenhower message was relayed, a statement by Army Secretary Wilber M. Brucker, which was recorded and stored on tape before launch, was broadcast from Courier.

Although Courier is considered a test vehicle, the Army said it is a forerunner of the more sophisticated Advent satellite, which last month was shifted to Army management from the Advanced Research Projects Agency.

Advent will go into a stationary 22,300 mi. equatorial orbit, with a network of three satellites placed equidistant around the earth for world-wide coverage. Emphasis will be on real time transmission, using voice signals. Avionics sophistication will come in advanced anti-jamming and command elements, modes and telemetry. (See story, p. 71.)

Long-lived Advent will weigh about 1,000 lb., and the Army says it can have it operative "in two years plus" at a cost exceeding $100 million.

Courier IB is the last flight payload in the Courier test project, but the Army has not determined whether it will develop this delayed repeater system further or go directly to Advent. Courier transmitters will be permanently silenced by ground command in about a year, but lifetime of the vehicle will be at least several decades.

Double successes of Echo passive reflector and Courier are certain to heighten the already intense industry interest in commercial communications satellite systems.

Initial three-month test plan is to exercise both orbiting and ground instrumentation by loading and unloading the satellite to capacity with teletype and voice signals, and by attempting facsimile transmissions. Video transmissions cannot be made since Courier has a band width of 50 kc. and television requires a width of 3-4 mc.

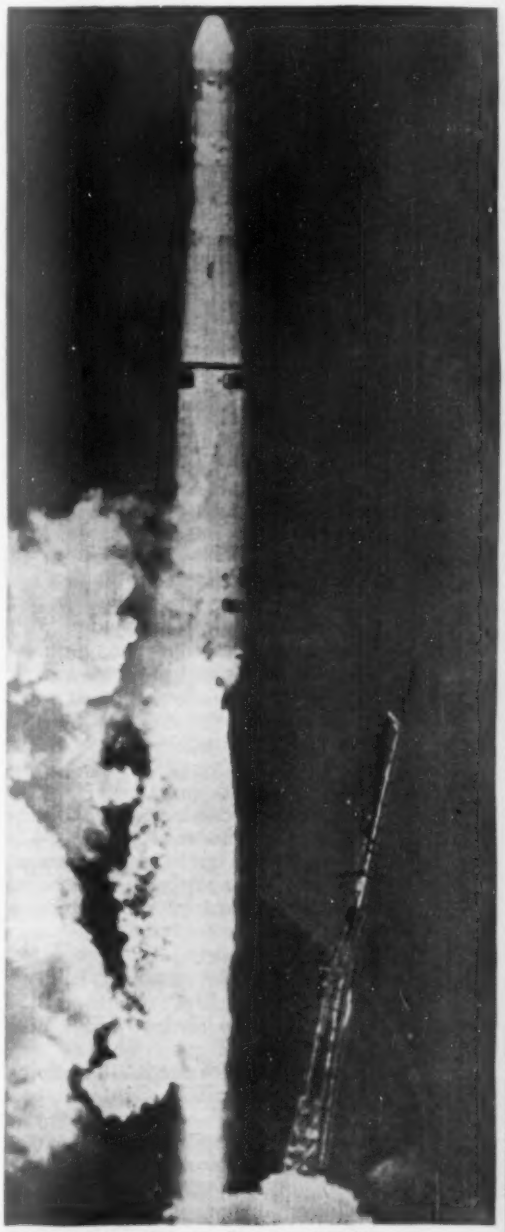
System contains two primary and two back-up teletype transmitters and receivers and a voice transmitter and receiver. Teletype recorders have a capacity of sending or receiving 55,000 characters per second when in view of ground stations. During nominal 14-min. pass over the two primary stations, capacity is 13.2 million characters.

Courier prime contractors working under Signal Corps management are Philco Corp., which built the payload; Radiation, Inc., designer of the Ft. Monmouth and Puerto Rico antennas, and International Telephone and Telegraph Laboratories, contractor for ground receiving, transmitting and control equipment.

Courier launch by the Thor Able-Star was the 100th time the Douglas Thor has been used as a booster. Vehicle now has a record of 31 successes in 37 space launch attempts, and 42 successes in 63 military test flights.

Two-stage Thor Able-Star configuration, 79.3 ft. tall with liftoff weight of 105,000 lb., employs standard military Thor minus guidance as first stage, and Aerojet-General Able-Star as second stage (AW Aug. 29, p. 50).

Thor burns 160 sec. Total Able-Star burning time is 300 sec., with the last 15 sec. of powered flight used to inject the payload into orbit. After burnout and just before separation, a pneumatic control system caused the second stage and payload to yaw 50 deg. to the right in order to place the solar cell array perpendicular to the ecliptic in full sunlight.



THOR ABLE-STAR launches Courier IB.

South African Station

Washington—Mobile USAF tracking station at Pretoria, Union of South Africa, used to confirm Courier IB orbit injection, has been labeled a U. S. missile base by Radio Moscow. U. S. ambassador to South Africa, Philip K. Crowe, countered that the tracking van is open for inspection and will be in South Africa about six months to track satellites.

Crowe said the USSR allegation that Zanzibar reaction to the Courier station there caused its move to Pretoria "is absurd and is a typical example of Soviet propaganda." Demonstrations against the Courier site in Zanzibar were reported last summer (AW Aug. 29, p. 92), and the station was canceled. The tracking van is located at Swartkops Airport, near Pretoria.

Defense Frees More Extra Funds, Leaving $288 Million Still Frozen

Washington—Defense Department has allocated more of the extra money Congress provided to accelerate defense programs, continuing its piecemeal use of funds the Administration said it didn't need when they were first appropriated.

Defense now has allocated all but $288.6 million of the extra money, a substantial decrease from the $621 million left after the Pentagon's Aug. 9 financial plan was issued (AW Aug. 15, p. 26). Congress provided a $40,362,108 military budget after making substantial changes in the Administration's proposed $39,685,000 budget.

Democratic critics of Administration defense policy call these increases in military programs vindication of their contentions that the U. S. should increase its defense effort when the appropriations were voted last spring. They also claim the Defense Department is actually still withholding about $450 million because $160 million has been withdrawn from obsolescent programs (AW Sept. 26, p. 25) and is available along with the $288 million to further accelerate the military effort.

Defense Secretary Thomas S. Gates, Jr., explained that these latest changes in the financial plan are based on technological and political grounds. He said that an annual budget cycle is no longer satisfactory and that defense spending will have to be revised periodically in the future, with the frequency of review dictated by technological and international political conditions.

Specific increases included:

- **Samos** reconnaissance satellite program; $33.8 million, which, when combined with $50 million released Aug. 9, makes a total of $83.8 million to "accelerate its capability" (AW Sept. 19, p. 26).
- **Polaris** missile program; total of $107.6 million, divided into $70.6 million for development of the 2,500-mi. A3 missile, and the remainder for purchase of the current version of the missile to arm Polaris submarines as they become available for operations.
- **Army** equipment; $25.2 million for purchase of tanks, personnel carriers, rifles and other field armament.
- **Anti-submarine** warfare; $55.3 million.

Largest block of funds still uncommitted are for the B-70. Congress voted an extra $190 million to accelerate the program over the $75 million Administration plan for developing only a flight test prototype. Defense released $100 million in August, and another $84.3 million is available when Defense and the Air Force settle on a final plan for accelerating the program. There also is $100 million appropriated for interceptors which can be switched to the B-70.

Defense still has $18 million appropriated for Polaris but not yet applied to the program, as well as $67.8 million for Army modernization and $8 million for anti-submarine warfare. Some of these funds will be reduced slightly by the 3% cut in procurement funds across-the-board voted by Congress.

Other Defense budget allocations will change these programs:

- **MATS interim modernization.** $83 million has been released for Lockheed C-130Es and when the Air Force decides on a second type of aircraft, there will be $117 million more available.
- **USAF has shifted** $10 million to begin studies of a tactical missile with a range of 1,500 mi.
- **Skybolt** air-launched ballistic missile. An additional $29.4 million has been allotted, making a total of $80 million.
- **Project Pluto** nuclear ramjet. Additional $7 million, for a total of $14 million.
- **X-15** research rocket powered aircraft. Additional $2.6 million, for a total of $8.6 million.
- **Dyna-Soar** boost glider. Additional $8 million, for a total of $58 million.

Democrats Sharpen Defense Policy Attack

Washington—Democrats last week sharpened their attack on the Administration's defense policies, charging that the President was prodded into stepping up total defense programs by a Democratic Congress and because of a presidential campaign.

Sen. Henry Jackson (D.-Wash.) chairman of the Democratic National Committee, said in a speech at Minneapolis that Democratic leadership in the Congress has long asked the Administration to do more where more is clearly needed. And while Congress voted the necessary funds for this purpose, he charged, the Administration has refused to spend the money, putting it in the "deep-freeze" instead.

Now however, the heat of the campaign is beginning to tell, and "some of the money is starting to drip, drip, drip, through the Budget Bureau," Sen. Jackson said.

About half of the existing and projected Polaris submarines were put into the budget only because of pressure by the Democratic Congress, he said. Administration leaders failed to take action on recommendations made by Congress earlier, but "in November they say 'it was our idea all the time.'"

"If it becomes the responsibility of the Democrats to propose a defense program to the Congress in January," Sen. Jackson promised, "we will ask for a stepped up effort" in missiles, aircraft, anti-submarine warfare, reconnaissance satellites and defense management.

"We should decide our defense program in the light of the danger," Sen. Jackson said. "Then we must find fiscally responsible ways of meeting these requirements."

Democratic presidential candidate John F. Kennedy also attacked the administration's defense policies, saying in Indianapolis that "our defense budget has not been managed in a way that assures us of continued superiority across the board—for the missile gap is widening, our conventional forces are outmoded, and our defenses are in danger of becoming second rate."

Eight Firms Submit OGO Spacecraft Bids

Washington—Eight companies have submitted proposals for a standard geophysical spacecraft which National Aeronautics and Space Administration hopes will be a flexible, modular package able to carry 1,000 lb. of instruments and in effect be an orbiting geophysical observatory (OGO).

Goddard Space Flight Center is evaluating proposals and expects to award a contract before the end of this year (AW Sept. 5, p. 26). Schedule calls for delivery of the S-49 prototype about 15 months after contract award and delivery of the flight model six months later.

Launch is scheduled in early 1963. The S-50 prototype is scheduled for delivery in late 1962, with the flight model coming six months later and launch in mid- or late-1963.

Compartmented spacecraft will house a variety of instruments in a highly-elliptical (150 naut. mi.-60,000 naut. mi.) orbit programed for Thor-Agena B payload S-49, and in the low orbit (150 naut. mi.-600 naut. mi.) S-50 Thor Agena polar satellite. Experiments will monitor and diagnose energetic particles and study the earth's ionosphere and plasma, magnetic field, cosmic dust and large molecules, pressure, density and temperature, radiation and astronomical effects.

Goddard has received proposals from Aerojet-General Corp., Bendix Corp., Convair Division of General Dynamics Corp., General Electric Co., Grumman Aircraft Engineering Corp., Lockheed Aircraft Corp., Radio Corporation of America, and Space Technology Laboratories, Inc.

NASA May Try New Technique On Next Echo Inflatable Sphere

Washington—A stiffened inflatable sphere is under consideration as the next Echo payload because the success of Echo I makes questionable the value of launching another non-rigid communications test satellite (AW Sept. 26, p. 31).

National Aeronautics and Space Administration now is weighing the merits of rigid vs. non-rigid inflatable structures in its over-all program to develop a commercially-usable passive communications reflector.

A rigid sphere is expected to have a much longer useful life than a non-rigid satellite because it will retain its shape longer and its greater weight-to-frontal area ratio will lessen the effects of solar and atmospheric drag.

If NASA chooses a rigid sphere, it will have to do so at the cost of time for development and testing, possibly including ballistic flights like those made with the non-rigid sphere from Wallops Island, Va.

NASA had planned to launch the third and last Echo development sphere late this year or early next year, but probably will not as long as Echo I remains a useful relay satellite. The agency last week predicted a one-year lifetime for the 100-ft. sphere, based on extensive orbital calculations.

Test Objectives Met

Echo I has succeeded in all three of its test objectives:

- **Study the effects** of the space environment on very large surfaces.
- **Measure reflectivity** and the manner in which radio signals travel through space.
- **Determine the feasibility** of inflatable spheres as worldwide communications reflectors.

G. T. Schjeldahl Co. of Northfield, Minn., which built the 100-ft. Echo I, said last month it is exploring a number of techniques for making inflatable space structures rigid. The company also said it can produce 1,000-ft. inflatable spheres.

Stiffening methods under study include making use of foam, photo-chemicals, solar radiation or electrostatic charge, and by increasing the tensile strength of metal foils. Other methods under consideration (AW Sept. 19, p. 54) are the use of umbrella-like stiffeners and inflatable ribs.

The pressure of solar radiation—amounting only to 1/50th of an ounce—is pushing Echo's perigee downward into the earth's atmosphere at the rate of 3.5 mi. per day and has changed its orbit from near-circular to elliptical, according to an analysis by Dr. Robert Jastrow and Robert Bryant of Goddard Space Fight Center's Theoretical Division.

From the launching date of Aug. 12 to Sept. 11, the perigee was depressed from 932 mi. to 864 mi. Atmospheric drag decreases the period about a second a week. The low total force of solar pressure and slight drag at such high altitude has so great an effect because of Echo's exceptionally high area to weight ratio of 50 sq. ft. per lb.—an average of 1,000 times greater than earlier satellites.

Because the orientation of the satellite's orbit to the sun changes with time, solar pressure later will return the orbit to a circle and the cycle will be repeated periodically. NASA predicts that the perigee will drop to a minimum of 716 mi. in mid-December and rise to 980 mi. by the middle of next April.

If the satellite remains spherical, its lifetime is expected to be one year—compared with an estimated 20 years, if solar pressure were not a factor.

Dr. Peter Musen, of the Goddard Theoretical Division, developed the theory used to calculate solar pressure. This and studies of atmospheric density were based on refined orbital characteristics computed under the direction of Dr. Joseph Siry, chief of the theory and analysis staff of Goddard's tracking and data systems directorate.

Density of the atmosphere at 932 mi. has been calculated to be approximately 1.1×10^{-18} grams/cm^3. Before Echo's flight, no certain density information was available for altitudes above Vanguard I's perigee of 400 mi.

Continued analysis of Echo's orbit should give data on the variation of density with time of day, disturbances on the sun's surface and solar flares. Echo has been crossing the U. S. chiefly during daylight hours in recent weeks, but will be visible at night more frequently this month.

Orbital elements as of early last week were—apogee 1,166 mi.; perigee 817.3 mi.; period 118.1 min.; inclination 47.24 deg.; velocity at apogee 15,269 mph.; velocity at perigee 16,383 mph.

Silencing Explorer

Washington—Explorer VII is expected to be silenced on Thursday, one year after its launching, by a Bulova Watch Co. timer set to operate on a one-billionth hp. battery. If the timer works, the Army Ballistic Missile Agency payload will be the first to be turned off automatically. Since some solar-powered satellites will operate indefinitely, timers will be used to silence others so satellite radio frequencies do not become overcrowded. Explorer VII has been transmitting data on radiation, micrometeorites, operation of its exposed solar cells and temperature.

House Group Reports On Engineer Hiring

Washington—Government contractors not only spend more money to recruit, but hire more scientists and engineers than firms working mostly on commercial business, the House Post Office and Civil Service Subcommittee on Manpower Utilization charged last week.

In a personnel recruiting cost study of 102 companies with military contracts, the recruiting costs of the 76 doing more than 50% of their business with the government amounted to $1,022 for each new engineer or scientist hired, compared with $751 for the other 26 firms, whose business is predominately commercial.

Results of the study, conducted by the Defense Department and released in the form of a subcommittee report, showed that new hiring of engineers and scientists by the 102 firms exceeded in general the rate of separation of engineers and scientists. The report also noted that the companies with predominately goverment business hired a relatively larger number of engineers and scientists during the year (Fiscal 1959) than did companies predominately working on commercial products.

"The high recruiting costs by many firms as well as the unusually heavy turnover of engineers and scientists in several companies, as reflected by this study," the subcommittee said, "would certainly appear to warrant even more attention in negotiating contrast costs and in specific auditing by the military departments." The subcommittee added: "The high recruiting costs also clearly indicate that the companies concerned have not made proper use of the free public employment services provided by our federal and state governments."

The report said an earlier study in 1957 resulted in considerable progress in controlling this particular item of contractor expense, but the subcommittee felt it needed a more timely report on the effectiveness of procedures, especially since the term "reasonableness" was used in allowing or disallowing such costs instead of setting quantitative standards.

Second World Speed Record Set By Navy-McDonnell F4H in Month

Washington—Navy set its second closed course world speed record late last month when Cmdr. John F. Davis flew a McDonnell F4H-1 around a 100 km. course at 1,390.1 mph., holding the fighter in a nearly constant 3g turn.

The Mach 2.3 record for the 100 km. closed course was set Sept. 25, 20 days after the F4H set a 1,216.78 mph. record for the 500 km. closed course. Both records will have to be certified by the Federation Aeronautique Internationale.

Official world speed record for the 100 km. closed course currently is held by the Republic F-105B, flown by Air Force Brig. Gen. Joseph H. Moore at 1,167.35 mph. Soviet Union submitted a 1,298.7 mph. record for 100 km. to FAI June 28, but this Russian claim has not yet been certified. Mark was set by an aircraft the Soviets designate the T-405.

Mixture of alcohol and water was sprayed into the F4H engine air duct ahead of the compressor sections of the General Electric J79-2 engines. Spray system was used primarily to reduce temperatures in the compressor above Mach 1.9, but it also increases engine power slightly. This cooling arrangement, designated pre-compressor cooling (PCC) system, is being developed for use as standard equipment when the F4H enters operational service late this year.

Aircraft flown on the 100 km. record flights was the second of about 30 which have been delivered. It was possible to use the PCC system to advantage on this aircraft because it has a slightly larger engine air inlet duct than most of the F4Hs now flying, and enough air could be taken into the engine to take advantage of the extra power offered by the compressor cooling. Even with the PCC system, the record-breaking F4H did not have as much power available as will production models after the 40th aircraft. These aircraft will be powered with J79-8 engines rated at 17,000 lb. thrust, or about 800 lb. more than the J79-2.

Circular Turn

The fact that the F4H could maintain a speed of better than Mach 2 during a 360 deg. circular turn 20.2 mi. in diameter is cited by the Navy as being the best possible indication of the maneuverability and interception capability of its most modern fighter.

Actual speed during the record turn was 1,454 mph. because the aircraft had to swing a little wide of the 100 km. circle to ensure that it traveled the proper distance. The F4H reportedly has exceeded by a substantial margin the 1,525 mph. speed record in straight and level flight set by a Convair F-106 interceptor almost a year ago.

Temperature problems get critical on the F4H airframe around Mach 2.4. The canopy, wing leading edges and tail surfaces all reach their red-line temperatures at about this speed. During maximum speed turns, the drooping horizontal tail also is subjected to additional heating because the engine exhaust flow balloons upward. These surfaces are made of titanium and steel honeycomb to compensate for this heating.

Original performance calculations had shown that the structural temperature limits would be reached at about Mach 2.1. Flight test data proved these estimates conservative by nearly 200 mph., so the PCC system was added to the aircraft to keep engine compressor temperatures within comfortable limits at higher speeds.

Flight Path Control

Accurate control of the flight path during a record run on the special course near Edwards AFB, Calif., is maintained through voice commands to the pilot from a ground controller monitoring the flight by radar. The pilot flies out 110 mi. from the circular course turns and accelerates at 45,000 ft. altitude along a straight flight path tangent to the course. Acceleration is timed so that the record speed is reached a few seconds before the aircraft reaches the point of tangency which is termed the gate.

The ground controller counts off the miles remaining before the aircraft enters the gate at the rate of about one mile every three seconds. Approximately one-half second before he reaches the gate, the pilot rolls quickly into a bank of approximately 70 to 75 deg. This puts him onto the course and the ground controller tells him when he needs to tighten or broaden his turn to stay just outside the course markers.

A series of high speed cameras photograph the flight around the course and provide the film record which is sent to the FAI in Paris for certification of the speed record.

India Buys Mi-4s

New York—Exact quantity of Soviet Mi-4 helicopters to be delivered to India (AW Oct. 3, p. 26) has not yet been determined, but a top Indian government official said here last week that "it would not be very many."

Finance Minister Moraji R. Desai said that the Indian Defense Ministry had concluded that the Mi-4 was more suitable for hauling personnel and cargo to remote military outposts in mountainous northern India. Performance and lower costs were cited as prime factors in the decision.

India has bought at least one Mi-4 and two Sikorsky S-62s for testing.

The transaction appears to be part of a larger deal involving Soviet transport aircraft, helicopters and engineering equipment for India's northern area development program. Soviet prices are reported to be 10 to 15% lower than prices for comparable American equipment. In addition, Russia will accept both export commodities in trade and rupees as payment whereas American companies are demanding dollars.

New York Contract Gain Reported by Sen. Javits

Washington—New York made slight headway in its drive to become "the number one defense contract state in the nation" in Fiscal 1960, according to Sen. Jacob Javits (R.-N. Y.).

Sen. Javits reported that this state's slice of total defense business increased from 11% in Fiscal 1959 to 11.7% in Fiscal 1960, while California's share declined from 24% in Fiscal 1959 to 23.7% in Fiscal 1960. New Jersey, which placed third as a defense contract state, obtained 6.2% of total Fiscal 1960 military procurement.

With Fiscal 1960 military procurement $1.6 billion below the level of Fiscal 1959, the dollar-volume of new contracts in both New York and California was down $31 million in New York and $443 million in California. Fiscal 1960 military procurement in New York totaled $2.38 billion. In California, it totaled $4.8 billion.

Sen. Javits commented: "The over-all improvement in New York's defense contract situation would certainly seem to indicate that, as a whole, industry's and labor's drive—spearheaded by the New York congressional delegation—to compete successfully for a larger portion of the military procurement dollar is beginning to show results" (AW June 29, p. 25).

Democratic presidential candidate Sen. John Kennedy supported New York's drive for more defense business during a campaign tour late last month. He said contracts should be distributed equitably and that special consideration should be given to areas where costs are lower and those where unemployment is high.

Greater Biosciences Effort Needed, House Space Committee Warns

Washington—More emphasis must be placed now on basic research in biology and development of life support systems if capabilities are to exist when they are needed for interplanetary travel, the House Committee on Science and Astronautics warned today.

While the House Space Committee, headed by Rep. Overton Brooks (D.,-La.) acknowledged that biological research in connection with space is vital to both the civilian and military space programs, its report on life sciences and space left unanswered the questions of where the work should be done, who should direct it and provide the funds and how an over-all comprehensive program should be planned and coordinated.

The committee concerned itself primarily with aspects of the life sciences which are of direct interest to the National Aeronautics and Space Administration. It made no attempt to build a full case for military interest in manned space flight, and it suggested further hearings be held before attempting to find the answers to the other problems.

Some space committee members feel that military programs, resources and facilities for space-oriented life science research should be expanded to meet NASA's requirements, while others urge that NASA be given the dominant role, leaving the services confined to research related to their military missions.

On NASA's responsibility in the field of life sciences, the committee said that:

• "**Work in the life sciences** needs proportionate emphasis with development of space propulsion, guidance, control, communications and structures if any significant capacity for manned travel is to develop and if major discoveries in space are to be made from effects on man and other living material.

• "**Particular attention** should be paid to long leadtime aspects of work in the life sciences, and the relatively modest investment this entails, if we are to extract full benefit in a timely fashion from operational vehicles of the Saturn, Nova or Rover classes five, 10 and 15 years from now.

• "**Congressional intent** should be made clear that in supporting an expanded effort in the life sciences, the executive branch is expected to carry out this expansion with adequate protection of our existing facilities and personnel against unnecessary duplication, or unused capacity which is still needed. . . . We must at the same time provide for adequate interchange of information and share the use of facilities and personnel so as to advance the national program with the greatest speed and economy. The committee bears in mind the particular responsibility which NASA has for taking the initiative in formulating a national program and in seeing that it is executed—regardless of where the work is done—in-house, in other government laboratories, or by outside contract.

• "**This committee suggests** that the charter of an inter-departmental coordinating committee in the life sciences related to space be spelled out in sufficient detail that this coordinating committee can know in a timely fashion what plans there are in NASA, in the armed services, and elsewhere in government, for projects, expansion of facilities and personnel so that it can propose best solutions from a national point of view and do so without undue delay or complexity in administration. Perhaps the NASA representative on the inter-departmental committee would be the most logical chairman.

• "**The committee recognizes** a particularly acute problem in expanding life sciences work will be the availability of high caliber personnel. Careful attention should be given to necessary transfers of personnel from existing laboratories and educational institutions to new ones that such moves represent the greatest good from the national point of view, and that at the same time a conscious effort is made to expand the long-run supply of trained scientists and technicians for such work.

• "**The committee is of the opinion** that only the surface has been scratched in careful study of the host of problems emerging in this field, and it intends to follow these matters over a period of time in the interests of public understanding and efficiency of operations.

"When the time comes to make intensive application of basic and other past knowledge necessary to sustained space flight," the report said, "results can be expected to be successful only if the basic knowledge accumulation has started long in advance, namely now. This is the kind of study which cannot be hurried beyond a certain point, seeking discoveries which cannot be predicted as to nature or timetable."

The report pointed out that there will also be some benefits which will come as a byproduct of the major effort to accomplish manned flight. For example, it said, work on acceleration stresses, particularly the sudden ones associated with emergencies, may lead to the design of safer automobiles and aircraft to reduce serious injuries in accidents.

Space Flight Records

Barcelona—Tentative agreement between the U. S. and Soviet Russia on standards for judging records set by manned rocket vehicle flights in space was to be submitted to the Federation Aeronautique Internationale late last week for formal approval.

The agreement—involving duration, altitude and weight—was reached in private talks by delegates to a meeting of the International Sporting Committee of FAI. At last year's FAI meeting in Moscow, Russia rejected the proposed rules, possibly because they might eventually require permitting foreign observers to witness Soviet space launchings. A proposal to admit FAI observers to launchings was deferred until a meeting planned for next March in Paris.

Definition of spaceflight in the proposed rules is flight to or above 62 mi. (100 km.) altitude. This figure is well within the capability of the Soviet rockets used for ballistic launchings of animals, and some U. S. observers believe Russia already has sent men to this altitude in ballistic flights.

Agreement on a dividing line between the atmosphere and space, even for record keeping purposes, could have an effect on current discussions over the legality of rocket and satellite flights over sovereign territory. There is no international legal definition regarding the dividing line, and specialists in space law have warned that if such definitions are not agreed upon soon, custom is likely to become accepted as law.

Carmichael Resigns Fairchild Presidency

New York—Resignation of James H. Carmichael as president of Fairchild Engine and Airplane Corp. was accepted at a board of directors meeting here last week, and Board Chairman Sherman T. Fairchild has become acting chief executive officer until a new president is chosen.

Two new board members were elected: J. B. Wharton, former vice president of The Martin Co., and Walter F. Burke, Jr., a financial consultant and director of Fairchild camera. They replaced Carmichael and James A. Allis, who had been a board member since 1941.

The board also announced that F. E Newbold, Jr., currently manager of the Stratos Division, would assume management of the other Long Island operations of the company—the Astrionics Division and the Plastics Division.

Scout Will Launch Satellite Next

Washington—First attempt to put a satellite into orbit using an all-solid propellant launching vehicle will be made in the next experimental firing of National Aeronautics and Space Administration's Scout. First completely successful firing of the four-stage vehicle last week sent a 78-lb. payload to an altitude of 3,500 mi.

Decision to try an orbital experiment this early in Scout's developmental testing program indicates that NASA has considerable confidence in a vehicle that has been plagued with rising costs and delayed approximately one year by management and technical troubles.

The satellite which may be launched this year probably will carry a meteoroid density measurement payload or an air density measurement payload, depending on the orbital altitude.

Scout was fired at 11:23 a.m. EDT on Oct. 4 from NASA's Wallops Station at Wallops Island, Va., at an angle of 5.5 deg. from the vertical and an azimuth of 107 deg.

Its payload, developed by Air Force Special Weapons Center to measure radiation in connection with monitoring of nuclear explosions in space, reentered the earth's atmosphere 80 min. later at a point over the South Atlantic 5,800 mi. from Wallops, and was destroyed.

NASA said preliminary analysis of telemetry data indicated that the flight was completely successful. This was the first successful firing by the U. S. of a fully-controlled and guided four-stage solid rocket and was the largest solid launched by the U. S. Scout is 72 ft. long and weighs 36,600-lb.

The 125-lb. payload section carried performance-monitoring telemetry, and the first and third stages carried some 80-lb. of similar instrumentation.

Scout was initiated two years ago in an attempt to develop a low cost sounding rocket and satellite launcher from existing hardware. First launching was at one time programed for the fall of last year. First attempt to test the previously unflown first and third stages failed last Apr. 18 when a heat shield covering the third stage came off, causing a structural failure prior to third-stage ignition.

First attempt to fly the full vehicle last July 1 was aborted by ground command before ignition of the fourth stage because Scout appeared to develop an excessively high rate of roll and to change its flight path. Later study of telemetry data showed that the vehicle did roll but that a sudden shift of the tracking radar was to blame for a false indication of a change in flight path.

Satellite for the first orbital try with Scout could be a meteoroid impact payload—carrying 160 pressurized cylinders about the size of beer cans and at least three other types of impact measuring devices developed by NASA's Langley, Lewis and Goddard Centers—an inflatable sphere similar to the Echo communications satellite, which would be used to measure atmospheric drag. Scout is expected to be able to put as much as 200 lb. into a 300 mi. orbit, send a 50-lb. payload to 8,400 mi. altitude, or provide nearly 2 hr. of zero-gravity time with 100-lb. payloads fired on ballistic trajectories.

Scout is managed from Langley Research Center by a group headed by James R. Hall. Lt. Francis E. Holly of AFSWC was project officer for the USAF payload, and NASA's Robert T. Duffy directed the launch team.

BTL Optical Maser

New York—Bell Telephone Laboratories last week demonstrated an optical Maser that produces an extremely narrow beam of coherent light whose intensity is a million times brighter than the sun. In demonstration, BTL scientists conducted pulsed-light communication over distance of 25 mi., using synthetic ruby Maser. Device has attractive possibilities for space vehicle communications (AW Feb. 22, p. 63; July 19, p. 96.)

Labor Chiefs Invited To Pentagon Meeting

Washington—Top labor leaders were invited to meet at the Pentagon last Friday by Secretary of Defense Thomas S. Gates in a move to cope with increasing jurisdictional strife over construction and installation jobs at ICBM bases (AW Oct. 3, p. 29).

In addition to this step, designed to speed completion of Atlas launching sites, the Defense Department moved to further tighten responsibility for the entire base construction program by assigning a third project, the $24 million Atlas base at Plattsburg, N. Y., to the Army Corps of Engineers' new ballistic missile construction office headed by Brig. Gen. A. C. Welling.

News Digest

Final agreement for European production of Raytheon Hawk surface-to-air guided missile (AW Aug. 1, p. 32) has been signed by five NATO nations—Belgium, France, Italy, The Netherlands and West Germany. Raytheon will receive $5,040,000 for patent and technical knowledge rights.

Two contracts, totaling more than $23 million, have been received by Sikorsky Aircraft for S-58 helicopters for use by the U.S. Marine Corps and the Navy.

Riddle Airlines will spend $9 million to buy seven Douglas DC-7Cs and spare parts from General Aircraft Leasing Division of General Dynamics.

Walter T. Bonney resigned last week as director of National Aeronautics and Space Administration's Office of Public Information to become director of public information for the Aerospace Corp.

McDonnell Aircraft Corp. was awarded a $108,965,525 Navy production contract last week to provide for delivery of the record-breaking F4H-1 all-weather fighter (see p. 32) through 1962. F4H contracts now total $368,896,000, accounting for 192 of the planned 400 aircraft production run.

Polaris missile with a new lightweight second stage was fired 1,000 mi. down the Atlantic Missile Range last week. Dummy warhead was carried in a test of the arming and fuzing mechanism.

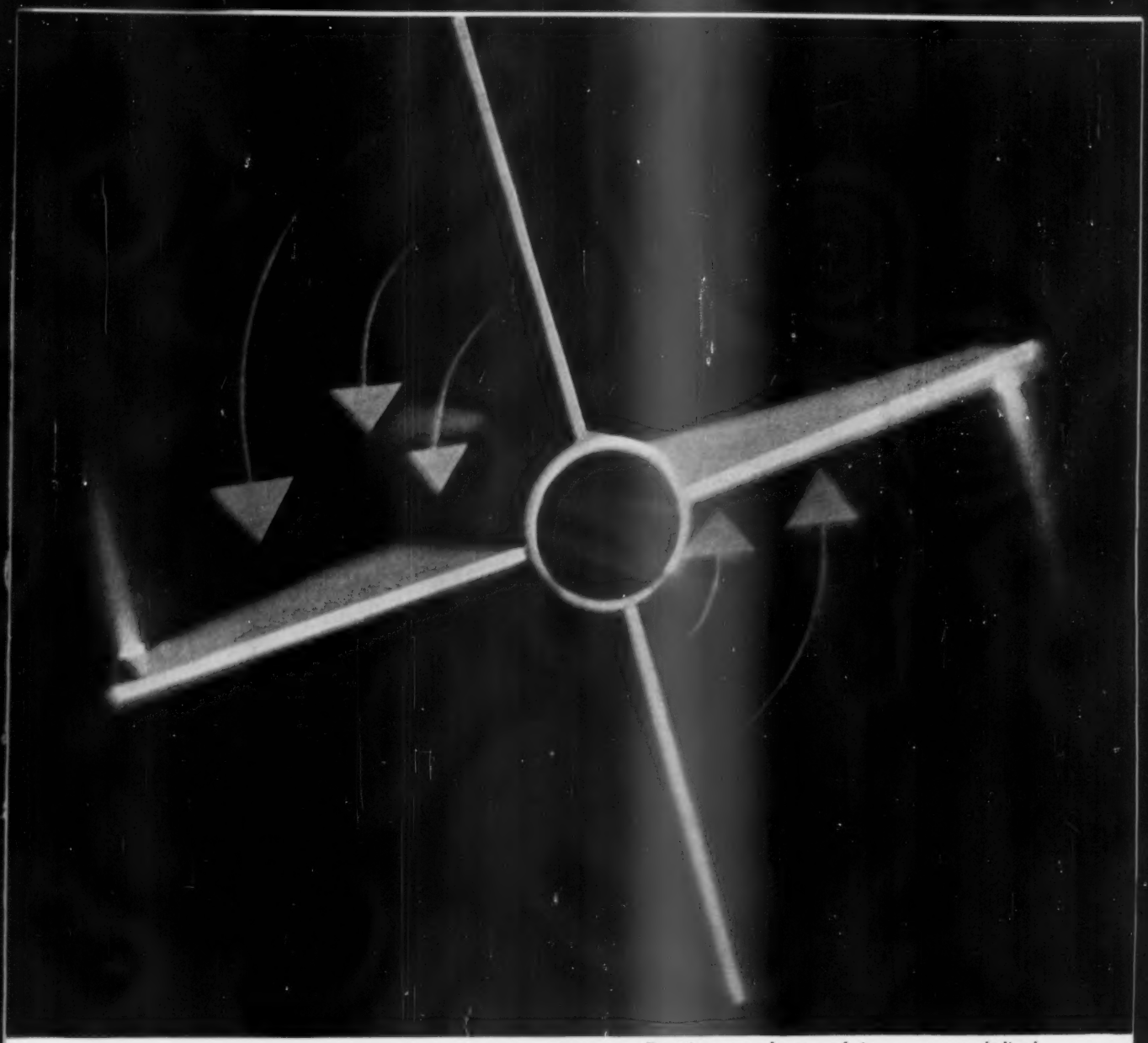
Seaboard & Western Airlines plans to relinquish its $4.25 million New York International Airport hangar to Pan American World Airways as part of a financial retrenchment program. If the move is approved by the Port of New York Authority, Seaboard & Western—which is attempting to raise $6.8 million from the sale of new securities—would share Hangar 3 at Idlewild with Northeast Airlines.

Navy-developed Martin Bullpup air-to-ground missile is being added to USAF's Republic F-105 fighter bomber.

Douglas Aircraft Co. has been awarded a $71.5 million Navy contract for all-weather A4D-2N attack aircraft, bringing the total for this model to $303.5 million.

Ninth Titan ICBM base will be built at Griffiss AFB, Rome, N. Y., at a cost of $80 million. It will include two Titan squadrons, handling 18 missiles plus two spares, dispersed in silos.

Eastern Air Lines last week ordered five more Boeing 720 medium range turbojet transports, for a total of 15 (AW Aug. 8, p. 43). Total cost is about $66 million.



Reaction controls at work in space — symbolized.

STEERING GEAR FOR ASTRONAUTS

Conventional aircraft control surfaces will not guide space ships and capsules. Rudders, ailerons and elevators find no resistance and hence produce no reaction to their movements where there is no atmosphere. Even at altitudes only half way up, they are sluggishly ineffective.

The accepted answer to a dependable steering mechanism for astronauts is a system of jet reaction controls developed and produced by Bell Aerosystems Company. First used on Bell's own supersonic X-1B several years ago, the system has been greatly improved and adopted for the X-15, the Mercury man-in-space project and other space vehicles.

Through strategically located, low and high thrust (1 to 1500 pound) rocket engines, Bell's reaction controls not only position and guide the ship by controlling the roll, pitch and yaw, but they also provide for orbit changes and retro-thrust. Some of the jets are throttleable while others can be operated in combination to provide the astronaut positive and flexible control.

This revolutionary steering gear for space, available using monopropellants or high energy bipropellants, is just one of many advanced projects which are currently engaging the diversified talents of Bell Aerosystems Company in the fields of rocketry, avionics and space techniques. Engineers and scientists seeking challenging, long-range career opportunities can find them at Bell.

BELL AEROSYSTEMS COMPANY

BUFFALO 5, N. Y.

DIVISION OF BELL AEROSPACE CORPORATION

Successor to the Defense Group of Bell Aircraft Corporation

Plumbing the Depths?

Alcoa goes to work immediately on defense projects

Aluminum is corrosion resistant in steam, high-purity water or salt water. That's why this water-compatible metal holds such promise in marine applications, as in atomic subs and cruisers, for example. Alcoa even anticipated the day when water would be the cooling medium for reactors that generate temperatures ranging from 500° and higher. We now have several new aluminum alloys able to handle these higher heats. Ask yourself where you can use them. For more information, write Aluminum Company of America, 2026-K Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Fuel Injection Failures Grounded Il-18

Quesada reports engine problem halted operations, calls Aeroflot operating facilities substandard.

Washington—Aeroflot's 80-95 passenger Il-18 turboprop transport has been grounded because of engine fuel injection failures which have caused burned out combustion chambers, according to E. R. Quesada, Federal Aviation Agency administrator.

Quesada, who returned last week from Moscow after a three week tour of the Russian airline's system, said the Soviets refused to admit that the Il-18 had been grounded but added that it was highly evident that the aircraft had been withdrawn from service to undergo a fleet retrofit program. He also said Aeroflot's operating facilities are below Western standards and added that the Russians admitted they were embarrassed about showing the group facilities at some points on the tour because of substandard conditions.

The FAA chief described the Il-18 as the "best airplane" the Russians have in their civil transport inventory and compared it with the Lockheed Electra. Soviets indicated that the Il-18 will be back in service soon (AW Aug. 3, p. 40).

Quesada was unimpressed with the An-10 turboprop transport, and in commenting on the Tu-104 turbojet transport, which he piloted during one stage of the tour, he noted that the aircraft "has stick control forces higher than the B-17. Because there is apparently no hydraulic control system, it takes two pilots to work on the wheel." He also noted that the Russians "must have had some very good engineering" on the Tu-104 powerplants, which have a high thrust-to-weight ratio, but added "our airlines could not use the engine because of its high fuel consumption."

He said that the Russians would not comment on the delay in introducing the large Tu-114 turboprop or the highly-touted Tu-124 medium-range transports into service. Both planes were slated to see scheduled service this year, according to earlier Russian announcements. Originally, the Tu-114 was earmarked for service in the summer of 1959 in three configurations: 220 tourist seats, 170 standard and 120 seats in the intercontinental version. Late last year, inaugural date was postponed to spring 1960, but is still not in service.

Immediately prior to his departure from Moscow, Quesada said that Aeroflot officials talked in terms of using the Tu-114 if and when a route to New York develops. He said that Soviet officials showed enthusiasm over the new An-24 turboprop transport (AW June 6, p. 37) but were rather unenthusiastic about the Tu-124 twin-jet (AW Aug. 22, p. 43), which they seemed to regard as "too hot" for its purposes.

He said here that he "was under the impression" that the Russians have launched a supersonic transport program, but he felt that the plane was being designed for "speeds under Mach 2" and that it would be ready for flight within five years.

The 10-man delegation visited Aeroflot stations and facilities at Moscow, Leningrad, Kiev, Tashkent and Samarkand. Other members of the group were Stuart G. Tipton, president of the Air Transport Assn.; Waldo Lynch, assistant vice president, Pan American World Airways; Raymond Dunn, vice president, Trans World Airlines; Hans Heymann, Jr., Rand Corp.; Raymond Maloy, P. D. McKeel, Arthur Catudal, all of the FAA, and State Department translator Alexander de Bilderling.

Quesada's Observations

In Moscow, Quesada gave this rundown on his observations during his visit:

• **Airports.** Landing fields, particularly runways, are not as good as the delegation expected. They were rough in some cases and too short for the large transport aircraft used by Aeroflot. For example, the wheels of the Tu-104B jet transport in which the delegation left Tashkent rose from pavement with only a fifth of the runway left, instead of about one-half which would be standard in the U.S. "There is no margin for engine failure at all," he said.

• **Pilots.** "Pilots are quite good. I would judge they [Aeroflot] are very stringent in crew selection. I think those fellows in the Tu-104 have had a lot of train-

Birds May Have Caused Electra Crash

Crash of an Eastern Air Lines Lockheed Electra last week into Boston Harbor with the loss of 61 lives set off renewed congressional demands that the turboprop transport be grounded.

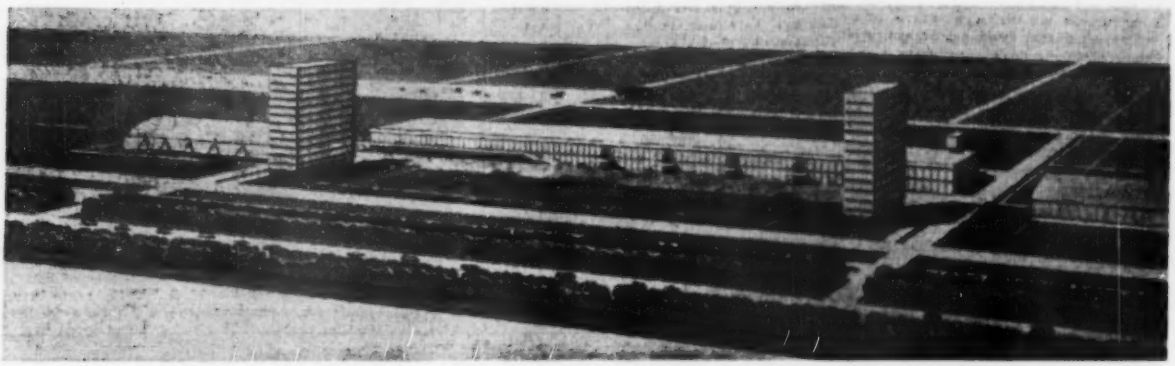
Federal Aviation Agency Administrator E. R. Quesada said he would not ground the Electra because there was no evidence of structural failure involved in the accident, which was the fifth in less than two years of service for the plane. The FAA chief said all evidence indicated the Boston crash was caused by a collision with hundreds of starlings which may have been caught in the engine intakes, producing a "flameout" condition.

The Eastern aircraft was taking off late Tuesday afternoon from Runway 9 at Logan International Airport on a flight to Philadelphia, Charlotte, Greenville and Atlanta. Wind and weather were normal, with a visibility of 15 mi. The plane reached an altitude of 200-500 ft., veered left, and traveled about 2,000 ft. from the end of Runway 9 before plunging into a channel in the harbor.

The Electra was carrying 67 passengers and a crew of five. Of the crew, only the two stewardesses survived. One reportedly received only minor injuries and the other a broken pelvis.

Sen. Vance Hartke, (D.-Ind.) revived a running controversy with Quesada by demanding that the Electra be grounded and that Quesada resign his job. Quesada replied that he was unaware of any "technical background" possessed by the senator.

Meanwhile, Lockheed Aircraft Corp.'s line at Burbank is full with ordered but undelivered Electras having fixes incorporated as they go through the line. These modifications are designed to correct the structural flaws which caused two of the Electra accidents (AW Aug. 8, p. 39). First of the planes with fixes built in is expected to fly this month, and the first airline Electra to come in for the modifications is scheduled to arrive in mid-November.



Soviets Building Downtown Moscow Air Terminal

Moscow's new downtown air terminal—on which construction began recently—is designed to handle more than 50,000 passengers daily and as many as 3,200 hourly during peak periods. Located on a 50-acre site along busy Leningrad Prospect, this drawing shows three buildings. Main two-story structure with ticket counters, waiting rooms, restaurant, etc., will be more than 820 ft. long. Two modernistic 12-story buildings will be built near each end of the main structure but closer to the street. One of these will be a "first-class hotel for in-transit passengers." The other will house offices and service facilities. The concrete, glass and aluminum terminal will be connected by escalator with a new station on the Moscow subway. Helicopters and special express buses will take departing passengers directly to planeside at the Russian capital's principal airports and bring incoming passengers back to the downtown terminal.

ing. Their ability, for example, to hold a proper approach speed is highly developed." The FAA chief noted that the Tu-104 over-the-fence speed is some 180 mph., compared with some 125 mph. for the Boeing 707.

• **Navigation facilities.** "Soviet navigation aids are below the world standard." Radar coverage is substandard, both en route and at terminal areas. Control towers exercise en route and terminal traffic control but "in a very crude manner." They do not appear to have properly equipped alternate airports available, he added.

• **Maintenance.** Aeroflot's overhaul system is "almost up to world standards." The maintenance program is organized much like that in the U.S., with 100 and 500 hr. checks. However, line maintenance facilities "are certainly below world standards. I saw no line maintenance facilities which were not outdoors anywhere in the Soviet Union."

German Helicopter Order

Bonn—West German Defense Ministry has decided to defer a planned order for U.S. built turbine-powered helicopters until sometime next year and will buy approximately 75 Sikorsky S-58s or Vertol H-21s as an interim measure.

The decision on the purchase of piston-powered helicopters is expected to be made within the next few weeks. The plan to defer orders for turbine-powered helicopters—either the Sikorsky S-61 or the Vertol 107—is reportedly based upon the hope that additional U.S. military purchases will lower the unit cost of one or both of the vehicles. A defense ministry spokesman said last week, however, that he "could not confirm" this.

• **Aircraft.** The delegation did all its traveling in a Tu-104B, but Quesada said the Russians are leaning toward the turboprop aircraft instead of turbojets because of economy factors.

At National Airport here, Quesada said that the Tu-104 is used as a prestige device within the Soviet Union as a means of bolstering Communist morale, particularly in Siberia. He enlarged upon his Moscow comments on air navigation and air traffic control facilities by describing them as antiquated and about on par with those available in the U.S. 20 years ago.

Soviet Traffic Density

He said, however, that Russian traffic density in the air is about the same as it was in the U.S. 20 years ago, so most flights are being handled adequately outside of Moscow.

Only ILS facility in the Soviet Union is located at the Moscow airport, but this unit, Quesada said, is not compatible with International Civil Aviation Organization requirements. He said the British had delivered an ILS unit to the Russians but that it had not yet been installed.

He praised the approach light systems of the Russians and pointed out that there are more approach lights installed at Russian airports than in the U.S. and added that the distance the lights extend beyond runway thresholds is greater than that in the U.S.

Quesada estimated that it would take about six months for the Russians to bring the Moscow airport up to Western standards "if they put their minds to it." He emphasized that the U.S. will insist upon an adequate alternate airport before U.S. carriers would be authorized to serve Moscow and noted that "Copenhagen now appears to be the only suitable alternate to Moscow."

He said bilateral negotiations would not begin during the present political atmosphere, in which detention of two RB-47 crew members, shot down over the Barents Sea, is a symbol. In Moscow, he said that full engineering data on aircraft to serve New York would have to be made available to the U.S. so determination of safety factors could be made. Crew qualifications also must be scrutinized, and FAA would insist upon the right to participate fully in accident investigations inside the Soviet Union.

Quesada said here that he made his blunt observations and critical comments to Aeroflot chief, Col.-Gen. Evgeny F. Loginov, before making them publicly.

CAB Approves Loan For Bonanza F-27s

Washington—Civil Aeronautics Board guaranteed a $1,125,000 Bonanza Air Lines loan last week for the purchase of two Fairchild F-27 turboprop transports.

However, the Board criticized a prepayment penalty included in the loan agreement between Bonanza and the Girard Trust Corn Exchange Bank of Philadelphia. The loan is to be repaid in 10 years at an interest rate of 6% annually. The loan is to be secured by a first mortgage on the purchased F-27s, which cost a total of $1,475,305.

The CAB criticized loan terms which "severely" restrict Bonanza from paying the loan ahead of schedule and said that in the future it will require " . . . that restrictions against prepayment be limited to a reasonable prepayment penalty."

Few Changes Foreseen in IATA Fares

By Robert E. Farrell

Cannes, France—International Air Transport Assn. annual traffic conference is entering its fourth week here with most of the 70 member airlines in agreement to maintain the present general fare level beyond next Apr. 1.

Two of the sharpest issues under debate reportedly are centered on Qantas' continuing demand to introduce jet sleeperette service on its long-haul transpacific routes and a demand by three U. S. carriers to drastically overhaul North Atlantic cargo rates. Conference observers, long used to the IATA traffic debates, felt sure neither issue would deadlock the meeting. It was expected Qantas' demand—which some observers suspected was being laid down by the Australian government—will be met by a compromise recognizing the problem posed by the Australian carrier's lengthy routes.

The North Atlantic cargo issues very likely will be handled by a conference agreeing to postpone U. S. carriers' demands until the matter can be again taken up in a special meeting early next year.

If the conference unfolds in this expected manner, the meeting here should wind up late this fourth week.

Barring a last-minute reversal, the trend after three weeks of debate seems to be maintenance of the present fare structure for another tariff year starting Apr. 1. There were, of course, minor adjustments in just about every traffic region. But no major fare change seems to be in the offing.

On the North Atlantic, for example, most carriers reportedly were agreed to hold the present fare level for another year. This would be done to give carriers more time to study the market effect of the 17-day excursion fare which went into effect Oct. 1. The excursion fare was decided on at the IATA emergency traffic meeting in Paris last March.

The carriers also devoted considerable discussion to the future introduction of group travel discount rates on the North Atlantic. Such discussion stems from the desire of certain North Atlantic operators to meet growing competition from charter flights. However, it was not expected that this conference would decide the issue now.

The only North Atlantic fare changes reportedly in the offing center on minor adjustments between European points and U. S. West Coast gateways. Aer Lingus, which shortly will be operating jets over the North Atlantic, seemed likely to win approval for its request that Shannon-New York jet fares be lower than London-New York jet fares.

Mid-Atlantic fares, which underwent previously agreed upon changes on Oct. 1, largely will remain in effect beyond next Apr. 1. Certain carriers, however, reportedly were pushing for higher jet differentials as well as special excursion fares across the mid-Atlantic.

Cubana, for example, put in a request for a $400 round trip-off-season excursion fare between Cuba and Spain. It was also reported that the new economy fare of $269 between Bermuda and Lisbon had won approval.

The transpacific squabble stems from Qantas' continuing demand that something be done about "getting passengers' legs off the floor" on the carrier's long-haul route over the Pacific. This issue was the sole tariff matter unsettled in last year's Paris emergency session. It also helped bog down the earlier IATA session at Honolulu.

Complaints Received

Qantas told the conference it has been getting considerable complaints from first-class passengers because of the lack of leg room on long flights. The carrier reminded the meeting it had earlier requested permission to offer four-abreast sleeperette seats with a 10% surcharge. Now it agreed on the main proposal of five-abreast instead of four.

Such an arrangement, Qantas argued, eliminates complaints that its original four-abreast sleeperette arrangement is uneconomical. Qantas also warned the meeting that unless its request was approved IATA might find itself particularly charged with standing in the way of the passengers' desires.

Qantas' proposal reportedly touched off stiff resistance by other carriers which apparently are worried about the repercussion of such service on their own first-class jet routes. One of the results of the Paris emergency session last March was a general agreement that, as a final communique read, "It was unnecessary during the period of the present rate agreement to provide either berth or sleeper-type seats in jet aircraft." Qantas apparently now wants to reopen the whole question.

It was understood that no other carrier supported Qantas' proposal and at midweek the issue still was hanging fire. Air-India, which reportedly abstained from voting on Qantas' proposal, indicated it did so because its sleeperette requirement is different. Air-India, however, very likely will go along with the majority desire to ban all such first-class "legs off the floor" proposals provided members agree to tighten up the use of flight lounge facilities.

The second controversial issue at Cannes—North Atlantic cargo rates—came as more of a surprise than the transpacific squabble. This was due to the fact that three U. S. North Atlantic cargo carriers—Pan American, Trans World Airlines and Seaboard and Western—jointly introduced a four-point program designed to overhaul North Atlantic cargo rates. This marks the first time that U. S. carriers have approached the North Atlantic cargo problem on a common front.

It was understood that the joint U. S. position was put together during the Cannes session—not beforehand. Apparently the three carriers made the decision that since their positions were much the same they ought to be presented in common.

The U. S. joint cargo plan is based on the need for a rating scheme which would be attractive to shippers, freight forwarders and the airlines. It was understood the four-point plan provides for a lower register of rates including fixed charter rates of 18 cents per ton-mile and a 9,000-kilo general cargo rate of 20 cents per ton-mile. A second and third register of commodity rates would fill out the plan and thus present a broad spectrum of rates which the joint proposals feel will put cargo operations on a more economical basis and protect scheduled cargo service.

The joint U. S. cargo project was opposed by most of the interested North Atlantic cargo carriers. Many claimed they needed more time to study the plan. Present North Atlantic cargo rates run out Mar. 31.

Thanks to Brancker

Cannes, France—A revolt by small carrier members of IATA over the forced resignation of John Brancker as IATA traffic director (AW Sept. 19, p. 40) came up briefly when the Cannes session opened (Sept. 19).

As a procedural matter, conference Chairman V. H. L. Dubourcq of KLM informed delegates that their former traffic director, John Brancker, would not be on hand, then moved a resolution thanking the resigned official for his past services to IATA. The resolution was seconded in what was described as a "moving speech" by W. G. Wood, Trans-Canada Air Lines vice president-sales and traffic. Then there followed a "significant silence" throughout the conference room. IATA gratitude was expressed to Brancker in a cable. Sir William P. Hildred, IATA director general, took over the post as acting traffic director for the conference.

MATS Aims at Turbofan Airlift by 1964

By Erwin J. Bulban

Tulsa, Okla.—Turbofan-powered cargo transport covered by Specific Operational Requirement 182 is required to modernize Military Air Transport Service to support a brush-fire or United Nations Congo-type operation while retaining a strategic airlift force capable of an emergency war operation, air logistics industry representatives were told here last week.

USAF has concluded that the SOR-182 airplane is the type that can handle much of MATS' required strategic and tactical airlift, according to Brig. Gen. Willard W. Smith, deputy director of operational requirements and deputy chief of staff for operations, Headquarters, USAF.

Gen. Smith said that USAF will designate a contractor to develop the SOR-182 transport early next year and that it is hoped that the airplane will be operational by 1964.

Previously, USAF Chief of Staff Gen. Thomas D. White told a congressional committee that military requirements call for 376 of the SOR-182 type aircraft.

The Air Force hopes that the basic configuration will be such that it will also meet the long-haul requirements of commercial all-cargo operators, since purchase by both military and civilian users will spread costs and enable the Air Force to budget more of these new airplanes than if it is the sole purchaser.

Federal Aviation Agency is working closely with the Air Force on the project in an effort to make both military and civil versions compatible. Results of an FAA survey of air cargo operators as to their needs has been incorporated in the SOR-182 study and Air Force representatives here said that USAF will do its utmost to incorporate FAA requirements into the new airplane.

Feeling among some air cargo operators that USAF requirements in such an airplane will tend to increase both initial and operating costs was minimized by both FAA and the manufacturers' technical personnel. They feel that any increase in initial cost due to incorporation of specific military equipment will be offset by the fact that Air Force will be bearing the development costs and that possible increase in operating costs will be offset by reduction of initial costs brought about by quantity production ordered by USAF.

Cost of approximately $5-$7 million per airplane in initial low quantities will come down to approximately $2-$3 million by the time commercial operators will be purchasing the airplane on the basis of production rates adjusted to handle the additional commercial orders.

A Boeing engineer warned, however, that incompatibility of military features with commercial operation could increase operating costs some 5-10%, a figure exceeding many operators' profit margins.

Feeling by air cargo operators that the airplane's airborne cargo jettison feature, for example, was not compatible with civilian needs was considered as being unfounded. Military officials, manufacturers and FAA believe that this will result in only a slight weight penalty, which is more than offset by the safety element it provides transoceanic operators in the capability for rapidly jettisoning cargo in event of emergency while flying overwater. SOR-182 is planned as requiring no state-of-the-art advances in design, to minimize development and operational costs and provide maximum reliability by utilizing well-proven ideas and equipment.

Requirement calls for payload of approximately 20,000 lb. for the 5,500-naut.-mi. stage lengths required on transpacific operations and 50,000-lb. over 4,000-naut-mi. stage lengths of transatlantic flights. Airplane actually would be planned toward a 70,000-lb.-payload, but emergency war operation studies by Air Force show an average of 50,000 lb. is required for most trips.

USAF is requiring a full-load takeoff field distance of 6,000 ft. over a 35-ft. obstacle, with high-flotation landing gear and a footprint of 50 psi. fully loaded to increase flexibility of airport operations.

Cargo compartment dimensions required are based on the emergency war plan, with cross section being of primary consideration and over-all length a secondary consideration. Although cross section of 12 ft. x 12 ft. was felt most desirable, indications were that these dimensions would seriously compromise the airplane's performance, so USAF settled upon a cross section of 9 ft. high x 10 ft. wide, which would entail a cargo compartment length of approximately 70 ft. long to accommodate the planned payload.

Rapid loading and unloading is a necessary feature, since block speed of the airplane is dependent upon turnaround time and airport congestion attendant to wartime operations make it necessary to get aircraft in and out quickly. Truck-bed height is specified for the cargo floor to provide straight-in loading capability and obviate the need for complex new loading equipment. Doors fore and aft also should be provided to permit simultaneous loading and unloading at several points.

Four-man crew plus space for a check pilot is included in the requirement with provision made for carrying an alternate crew. USAF apparently will consider a cockpit arrangement that will also meet civil requirements.

Gen. Smith also noted that USAF

New Sabena Routes

Brussels—Sabena Belgian World Airlines, struggling to overcome the economic impact of the loss of its routes to and within the former Belgian Congo, is planning transatlantic jet service to Mexico City and a unique pool agreement that will give it access to the tourist center of Las Palmas in the Canary Islands off Africa's west coast.

Under a bilateral agreement with Mexico, Sabena on Dec. 2 is scheduled to begin Boeing 707 service to Mexico City via Montreal on a twice-a-week basis. Total elapsed time for the westbound flight is estimated at 13 hr. 13 min.; for eastbound flights with more favorable winds, 11 hr. 40 min.

The new route will mark Sabena's first invasion of the Latin American area, a market it is expected to try to exploit heavily in order to help offset the revenue loss from its severed Congo routes, which in the past accounted for approximately 40% of the carrier's annual revenue (AW Aug. 8, p. 49).

In another move, the Belgian airline is entering into a pool agreement with Aviacion y Comercio (Aviaco), the small Spanish carrier which has rights into the Canary Island port of Las Palmas.

Under the plan, Sabena-owned Douglas DC-6 aircraft painted in both Sabena and Aviaco colors will leave Brussels for Barcelona on Tuesdays and Saturdays and for Madrid on Thursdays. After landing in Spain, the aircraft will be taken over by Aviaco air crews and flown on to Las Palmas.

Aside from the obvious advantage of opening a city with strong tourist potential to Sabena and permitting it to offer through service from Brussels, the agreement provides Aviaco with suitable aircraft to effectively exploit its routes to the Canary Islands.

studies currently include additional air cargo concepts including supersonic type and a V/STOL small unit transport and supply aircraft. As in SOR-182, USAF will consider both military and commercial requirements in the supersonic type, which he described generally as having range capabilities of operating 3,500-naut.-mi. nonstop with payload of approximately 30,000 lb. for low-density cargo and 60,000-lb. for high density. The aircraft should be able to operate from present air bases and speed would be "just under the thermal barrier." He noted that USAF will develop a supersonic transport as more is learned about this regime.

The V/STOL requirement, a joint USAF-Army-Navy study, is contained in Document 145, which considers an airplane in the Fairchild C-123 size category, with capability of lifting a 10,000-lb. payload over a 1,500 naut.-mi. range at 400-kt. cruise speed and able to operate fully loaded from 500-ft. airstrips. Aircraft would have air-refueling capability.

Replacement for the turboprop Douglas C-133 is the least funded study program now, Gen. Smith noted, since this airplane is still coming off the production line. USAF will wait to see what effect the SOR-182 airplane has on strategic airlift capabilities before making any decisions on the larger type. Manufacturers' design views on the SOR-182 requirement were discussed before the meeting of the Institute of the Aeronautical Sciences (soon to be the Institute of the Aerospace Sciences) here by Lockheed-Georgia.

High-wing concept was visualized by Lockheed engineer A. E. Flock as best meeting the requirement for straight-in loading. Use of four 20,000-lb.-thrust-class turbofans would provide a cruise speed of 450 kt., although no specific value for this performance is specified by USAF. Design gross weight would be approximately 320,000 lb. and mission gross weight approximately 280,000 lb. to satisfy the 50,000-lb. payload requirement over 4,000 naut. mi. nonstop. Specific fuel consumption would be on the order of 0.75. For a 3,000-naut.-mi. range, payload capability would be approximately 70,000 lb.

Wing loading would be in the area of 80 to 100 psf. and fuel loading from 80,000 to 100,000 lb. with maximum payload to provide a good range situation.

Floor length of 70 ft. with floor loading design of 200 psf. and 750 psi. crush resistance and 20-in. grid tie-down pattern would result in floor weight of approximately 4.5 psf., he reported. Use of palletized loading, a concept favored by USAF, would provide further weight-savings of about 15%.

Opinions among many spectators at the IAS air logistics meeting here were that "warmed-over" conversions of passenger aircraft would continue as the mainstay of the air cargo industry for many years to come. USAF representatives said privately that they felt that the military could get a new aircraft that would meet more fully the requirement at less cost than would be involved in converting current jet transports, adding that a study on such a modification had been made and a report is due in USAF Headquarters this week as to the usefulness of current aircraft as a substitute for SOR-182.

USAF spokesmen stressed the need for maintaining MATS combat transport capability to be ready, without warning, to fly the emergency war plan at wartime utilization rates. Lt. Gen. William H. Tunner, USAF, (ret.), former MATS commander, stressed that the current MATS program and utilization is vitally required if the service is to meet its D-day requirement as laid down by the Joint Chiefs of Staff.

MATS' current utilization of some 4.9 hr. per day is the minimum it must maintain to carry out its transport and training missions, and it must be ready to expand immediately to 8-10 hr. utilization on D-day, Tunner explained. He pointed out that when the Berlin airlift crisis started, MATS was operating at a utilization of 2.7 hr. daily and had to strain to get to 8 hr. daily and nearly failed in the supply mission because of its short resources.

At the time of the Korean War, MATS was down to 2.7 hr. daily and the Joint Chiefs requested it go on 10 hr. a day at once to meet this crisis. With trained crews, equipment and parts lacking to meet this requirement because of its previous low utilization schedules, it took MATS months to get to 6 hr. daily utilization and the service never achieved the requested 10 hr.

Several helicopter configurations, including compound and crane types, were covered by Lewis G. Knapp, section head, preliminary design, Sikorsky Aircraft Division, pointing out that turbine engine developments have made possible payloads of more than 50% of the gross weight of rotary wing aircraft and outlined these design studies as fitting in the 1960-1970 helicopter requirement:

• **Compound helicopter,** with inverted high gull-wings, powered by two General Electric T64 turbines, having a cruise speed of 246 kt. and payload capability of 8,000 lb. This study covered a machine of 39,200-lb. gross weight and 24,200-lb. empty weight. Hover ceiling, out of ground effect, on standard day, was estimated at 8,000 ft. Economical cruise speed, at 10,000 ft., was estimated at 200 kt.

• **Flying crane** configuration, with 40-ton payload, powered by four modified Pratt & Whitney JT12 turbines. This aircraft would have a gross weight of 230,000 lb., carry 25,000 lb. of fuel and have a range of approximately 100 naut. mi. Cruise speed would be approximately 100 kt. Single main rotor would have a blade diameter of 160 ft. Over-all height for this crane configuration would be 32 ft. and over-all length would be 158 ft. Knapp considered the design within the current state-of-the-art ability to build.

To illustrate comparisons of a standard and crane configuration of a basic helicopter, both using the same rotor system and having a 10,000-lb. payload capability, Knapp showed that the conventional internal loading machine would have an empty weight of 9,950 lb., whereas the crane-type external loader would have an empty weight of 9,338 lb. Useful load of the former would be 7,750 lb. and of the crane 8,162 lb. Gross weight of both would be the same 17,500 lb. and both would have a cruise speed of 119 kt.

Loading time difference between the two configurations was marked: Knapp considered that it would take approximately 15 min. to handle the internal loading configuration as against one-third this time for the external-loader crane configuration.

Coach Fares Raised

Washington—Civil Aeronautics Board has permitted five trunk airlines to raise long-haul turbojet coach fares to bring them within 75% of first class fare levels on the same routes.

Increases were requested in order to narrow the gap between first class and coach fares on major transcontinental routes. Fare gap ranged up to 36%, and the carriers maintained this was uneconomical where both classes of passengers were flying the same aircraft. Airlines raising fares are American, Continental, Northwest, United and TWA.

CAB Wants Tariffs To Specify Aircraft

Washington—Civil Aeronautics Board is proposing a rule change for new tariffs that could require airlines to describe the types of aircraft to be used and their seating arrangements.

In proposing the rules change, which the industry is expected to oppose, the CAB said carriers would have to specify the type of aircraft, class of service, seating arrangements by number of seats abreast and rows of seats and the number of lounge seats to be left unsold and free for passenger use. The Board also would want information on the distance between each seat. Rule would apply to all tariffs filed after it went into effect.

Initial Capacity Restriction Drive Fails

By L. L. Doty

Copenhagen—First attempt by the U. S. to impose capacity restrictions on foreign flag carriers as a means of offsetting a growing torrent of competition on international routes serving U. S. markets apparently has failed.

At the same time, mounting pressure from other nations for more restraints on traffic capacity offered by U. S. carriers is forcing the U. S. into a tight traffic squeeze which conceivably could bring about a second drastic change in U. S. international civil aviation policy and which, in turn, could reshape over-all competitive route structures.

Only this year, the U.S. found it necessary to revise its traditional policy of an open market for all carriers to one of modified control over U.S. flag airlines' competitors (AW Aug. 1, p. 47).

The quandary in which the U.S. now finds itself entangled stems primarily from the almost impossible task of setting commercial competitive conditions at a high-government diplomatic level. And as long as U. S. carriers must operate at a profit as business ventures in competition with an increasing number of foreign flag carriers while, at the same time, relying upon the government to determine the quantity of that competition, the quandary will remain.

The solution, if there is any, and one which would involve the abrupt change in historic U. S. civil aviation policy, may lie in more government control of civil aviation—which will draw strong resistance from industry—or in the selection of "chosen instruments" or single operators on U. S. international route segments. Industry observers feel that either solution is a possibility, but it is considered unlikely that a move toward either will be made unless the industry suffers economic setbacks as a result of the competitive situation.

Here is how the U. S. stands vis-a-vis foreign nations in the international civil aviation field:

• **A virtual inundation** of airlines representing new nations is expected to flood the U. S. with applications for unrestricted traffic rights (AW Aug. 15, p. 41). Under the principle of reciprocity, the U. S. must grant these rights in return for rights the U. S. already holds to serve these countries. U. S. airlines are now operating into 23 countries which have a bilateral agreement with the U. S. but do not now return the service.

• **U. S. may be forced** to grant new markets to carriers already serving this country. For example, British Overseas Airways Corp. will soon request traffic rights at Los Angeles plus a new Australia/Los Angeles/San Francisco route. The British may grant TWA its long-sought Zurich/Frankfurt route as a bargaining trade for Los Angeles.

• **Capacity restrictions** will be imposed on U. S. Fifth Freedom traffic, or traffic carried by U. S. carriers from a second country to a third. This traffic is important to the U. S. For example, 65% of the traffic handled during the first six months of 1960 by Pan American out of Buenos Aires was Fifth Freedom, and it was 87% for Panagra in the same period. Demands for capacity restrictions have caused a number of bilateral negotiations deadlocks (AW June 13, p. 38). Chances are strong that the U. S. will be forced to accede to these demands, since threats to bar U. S. carriers from countries involved unless capacity limitations are put into effect can be, and probably will be, carried out. Because of the large number of airlines now serving global routes, most nations are no longer reliant upon U. S. carriers to maintain an aerial line of communications beyond their periphery as was the case immediately following World War II when initial bilateral agreements were negotiated.

• **U. S. will be forced** to change its tactical diplomacy if it is to realize any success in negotiating Fifth Freedom traffic restraints on foreign flag carriers.

Breakdown in negotiations with the Scandinavians here late last month (AW Oct. 3, p. 25)—negotiations which were originally viewed by the U. S. as a test case on how far it could go in placing a ceiling on traffic capacity—leaves the U. S. a victim of the type of open market and free competition it was so strongly championing until several years ago. With the influx of more seats on international routes, U. S. carriers—which devote a large part of their energies to competing with one another—are no longer such staunch supporters of freedom of the skies for all.

The State Department is not surrendering to the results of the talks here and will continue to seek some form of restrictions on Fifth Freedom traffic. In addition to the Scandinavian countries, Ireland, Switzerland, The Netherlands, Belgium—all countries which place a bread-and-butter value on Fifth Freedom traffic—will put up stiff resistance to any restrictions.

The Scandinavians, for all practical purposes, have successfully rebuffed the first U. S. drive to introduce some form of control over competition by refusing to submit to new U. S. interpretations of the bilateral pact and by brushing aside U. S. requests for Fifth Freedom traffic statistics.

So far, the U. S. has been stalemated in moves to exchange these traffic statistics with many countries with which it has bilateral agreements. Control of Fifth Freedom traffic is virtually impossible without the reciprocal exchange of traffic figures. The Scandinavians bluntly turned down this request.

The U. S. was no more successful in its attempts to persuade the Scandi-

Boeing 727 Decision

Renton, Wash.—Boeing Airplane Co. decision to proceed with its 727 transport project now depends on whether Eastern Air Lines and United Air Lines will undertake a financing program to back the purchase of 40 aircraft each.

The two airlines have presented letters of intent with open escape clauses to the manufacturer providing for a 60 day option period in which to work out financing for the aircraft, giving Boeing the same period of time to move ahead with final design work and decide whether to begin production on the strength of an initial order for 80 aircraft.

The Boeing 727 will be powered by three aft-mounted Pratt & Whitney JT8D-1 turbofan engines and will cruise at approximately 600 mph. with a range of 1,500 mi. It will accommodate between 70 and 120 passengers and cost about $4.5 million.

Bankers and insurance companies are now studying the project to determine whether they will be willing to underwrite the program at this time. Delivery of the first 727s has been tentatively set for 1963.

Aeroflot Jet Anniversary

Moscow—On the fourth anniversary of Aeroflot's first scheduled jet passenger service, Russia boasted that it is still operating more jet transports than any other nation. The Soviet press said that jets and turboprops are together serving "over 100" domestic air routes.

Aeroflot began scheduled Tu-104 jet operations in September, 1956, with a flight from Moscow to Irkutsk. The USSR's largest volume of turbojet traffic presently moves over the short-haul Moscow-Leningrad link, where 100-passenger Tu-104s make 10-12 round trips daily.

navians to accept its new interpretations of the Bermuda principle–formula on which the majority of U. S. bilateral agreements is based. The Scandinavians agreed to the Bermuda principle in 1957 after SAS had won a polar route between the West Coast and Scandinavia and have held to their own interpretations of the principles since then.

Key to the dispute during negotiations here was U. S. demands to control traffic moving beyond Scandinavia from the U. S. to third countries. The Scandinavians argued that such traffic was not Fifth Freedom traffic, that the U. S. had no control over it because it was traffic moving under the terms of bilaterals the Scandinavians had signed with the other third countries.

The U. S. invented the term "Sixth Freedom traffic" which it applied to beyond traffic and which, it claimed, was the same as Fifth Freedom traffic and therefore subject to control. The Scandinavians were willing to admit the new term but emphasized that there had been no mention of any relationship of Sixth to Fifth Freedom traffic in the Bermuda document or during the time the Bermuda Agreement was formulated or at the time when the five freedoms were originally evolved.

Scandinavian delegation here pointed to the main capacity clause of the Bermuda Agreement, which indirectly refers to Fifth Freedom traffic as international traffic "destined for and coming from third countries at a point or points on the routes specified in the annex to the agreement. . . ." Scandinavians argue that this specifically refers to traffic destined for and coming from third countries which are intermediate points on the main route specified in the agreement and does not pertain to traffic moving beyond the Scandinavian countries.

They held that, if Sixth Freedom traffic is the same as Fifth Freedom traffic, then Scandinavia has the right to control traffic moving from Scandinavia beyond terminal points in the U. S. named in the agreement.

The U. S. made several unsuccessful bids to compromise. For example, it proposed that any traffic which stopped-over in Scandinavia for 72 hr. or longer could be considered regular traffic, even though it moved beyond Scandinavia to third countries at a later date. This proposal was not accepted, presumably on grounds that acceptance would imply agreement with U. S. interpretation of Sixth Freedom traffic.

Patterson Urges CAB to Approve Sweeping Capital Merger Changes

By Robert H. Cook

Washington–Sweeping changes in Capital Airlines' management, working staff and route structure are being sought by United Air Lines as the only conditions under which it will agree to a Capital merger, now being studied by the Civil Aeronautics Board.

United President W. A. Patterson told CAB last week that failure to grant any of these conditions will mean "no deal" on the merger proposal.

United's terms were disclosed when the Board released transcripts of a discussion held July 28 between CAB and officials of United, Capital and Vickers-Armstrongs prior to the airlines' joint announcement of merger plans on the same day.

Meanwhile, CAB is upholding its promise to expedite the merger case application. It recently rejected demands by Eastern, National, Delta and other competitors that Capital's entire route system be investigated as part of the merger case, and a hearing before Examiner Thomas L. Wrenn has been scheduled for Oct. 19.

While the CAB is trying to expedite the case and directors of both airlines are in general agreement on proposed terms, the merger raises some thorny labor problems, and they are likely to be a main issue before the Oct. 14 meeting of stockholders of both airlines. If the Board approves the merger with the usual labor protection clauses, United may face significant labor problems for some time.

Basically, the problem is that United's labor groups, such as the Air Line Pilots Assn., Flight Engineers International Assn. and the International Assn. of Machinists, are in a better bargaining position by virtue of their greater number of members than the Capital unions. Merged seniority lists will be negotiated by the unions involved and submitted to the surviving company, as in the Delta-C&S merger.

United now employs over 1,500 pilots, of which an estimated 200 are considered surplus but are employed under a "no furlough" clause in ALPA's contract which expires Nov. 1. Capital has an estimated 700 pilots to merge into a combined seniority list. ALPA members at Capital already have expressed concern that the planned return of 15 Viscounts to Vickers-Armstrongs by United, plus Patterson's announced intentions to dispose of most of the remaining Capital fleet, will pose a serious threat to their employment opportunities within the new company.

United employs about 700 flight engineers who are FEIA members and are pilot qualified, compared with an estimated 50 Capital flight engineers who are ALPA members. In this case, Capital flight engineers would be faced with the choice of remaining on a combined ALPA seniority list, with the danger of being furloughed at a later date because of a low seniority position, or combining with United's flight engineers.

National Mediation Board has spent several months hearing arguments from ALPA that a "class and craft" determination for flight crews is needed at United. NMB approval of this request could have the over-all effect of placing all United flight engineers on an ALPA seniority list.

Problems also could arise from efforts to combine seniority for the airline's mechanics, since International Assn. of Machinists wage provisions vary a great deal between the two airlines.

Patterson has taken the stand that most Capital employes will be absorbed through general attrition and expansion of the United system, but he has made it clear that Capital's board of directors and management will be the first target for dismissal as one of the merger agreement provisions.

Criticizing Capital's management, Patterson said he had not determined which members were responsible for the airlines' troubles, but whoever it was, "I do not want these fellows. And I hope the Board does not write something in here whereby we are going to be forced to give these fellows a premium of 5 years or 5 months, or 3 years pay for a bad job."

United's president told CAB that he strongly favors Board approval of Capital's requests to abandon 28 stops on its system, an action which could result in a surplus of Capital employes.

"But for goodness sake," he said, "please don't come around later with a decision that Allegheny or any other airline who gets the stops didn't have to take them, but we must take the surplus people. They should go with the people who got the benefits."

Patterson also warned that any final signing of a merger agreement between the airlines will be dependent upon CAB lifting its current route restrictions on the United system in certain areas such as a Chicago-Washington route, where United must originate flights either in Denver or Omaha. In addition, he urged the Board not to place another carrier in the Chicago-Washington market because of the dangers of over-competition.

PARIS, PORTLAND OR PADUCAH—
THEY'RE ALL THE SAME
TO THIS COMPANY AIRPLANE

(it's a Lockheed JetStar!)

AND PRATT & WHITNEY AIRCRAFT JET ENGINES HELP MAKE IT POSSIBLE

The new Lockheed JetStar has intercontinental capabilities, yet can land at the smaller airports. Overseas or overland, you fly jet-fast and in jetliner comfort. Take-off time is at your convenience. Four Pratt & Whitney Aircraft JT12 engines power the JetStar. Each weighs only 436 pounds but develops 3,000 pounds thrust—one of the most efficient and reliable powerplants ever developed. Its simple, rugged design makes for easy maintenance and high operational reliability. The JT12—backed up by Pratt & Whitney Aircraft's world-wide service—is an engine conceived, designed and built for business use. It's one reason why many leading firms in the U.S., Canada and Europe have ordered Lockheed JetStars.

PRATT & WHITNEY AIRCRAFT
East Hartford, Connecticut
A DIVISION OF UNITED AIRCRAFT CORPORATION

Airport Area Land Use Problem Studied

Washington—Dealing with mounting problems of turbojet noise effects on real estate values in airport areas has become a top priority project with the Federal Aviation Agency, which is now exerting a strong influence over airport area residential construction through close liaison with the Federal Housing Administration and other government agencies.

Urban population growth in formerly rural areas around many jet terminals in the past two years has spurred FAA, FHA and the Urban Renewal Administration to join forces to combat related problems—FAA's problem of public complaints over turbojet noise, FHA's mortgage insurance risk, which could be increased by a drop in real estate values because of noise, and URA's responsibility to prevent urban blight that could result from any significant decrease of values.

Typical of the growing community concern over this problem are the observations of the New York State Commerce Commission, as expressed by Commissioner Keith S. McHugh last week before a meeting of the State Aircraft Development and Operations Conference:

"Only a few of our communities have zoned their airports, and even these gave very little thought to the noise problem," he said. "In the past the primary purpose was to prevent the erection of structures which might interfere with the glide or takeoff slopes of aircraft, but experience has proven that it is just as important to prevent the growth of communities in approaches to airports as it is to prevent the erection of structures."

Through its control of federal funds for airport construction, plus rules for turbojet takeoffs and landings, FAA has been attempting to alleviate much of the public protest against jet noise, but lacks authority to ward off this problem in the critical fields of construction and zoning in areas adjacent to airport property.

FAA-FHA Coordination

In practice, FAA has succeeded in preventing a great deal of residential building, either in too close proximity to airports or beneath approach patterns, through the cooperation of the FHA. The housing agency has rejected many mortgage guarantee loans for houses and apartment projects on the basis of advice from the aviation agency.

However, neither FAA nor FHA have been able to exert any concerted power to avert these problems at their source by influencing local zoning commissions to tailor land use patterns in airport areas to permit the economical operation of aircraft without the problems of public objection to turbojet noise as a nuisance or threat to property values.

Solution of a majority of the existing problems and those of the future, both FAA and FHA officials feel, could result from a combination of a special zoning study project now being conducted for the Detroit Metropolitan Wayne County Airport under a grant from URA, and from FAA's suggested noise abatement program for airports, now being studied by FHA and other agencies.

While FHA has been rejecting loan guarantee applications on an individual basis after consultation with FAA, adoption of the aviation agency's airport noise abatement program would provide the housing agency with its first yardstick to judge future applications within a framework of actual topographic limitations for construction surrounding airport areas.

At the same time, both the Federal Aviation Agency and the Urban Renewal Administration hope that a final report on the Detroit survey will serve as a nationwide model of land use planning and zoning in airport areas.

The first specific study of this type underwritten by URA, the Detroit survey will take nearly two years to complete at a cost of $45,000, of which $30,000 has been provided by the government. Balance of the cost is being carried by Wayne County, the Detroit Metropolitan Area Regional Planning Commission which is conducting the study, Romulus Township where the airport is located and the Romulus Township School Board.

Using the Detroit Metropolitan Wayne County Airport as a "laboratory," located in a sparsely populated area 16 mi. from the center of the city, the planning commission has selected the following objectives:

- **Determine the acoustical** and vibration levels created by jet aircraft operations.
- **Outline the area surrounding** the airport which is adversely affected by such operations.
- **Examine existing** land uses in the study area.
- **Determine the area's** potential development with emphasis upon business activities which the airport may expect to attract.
- **Develop a land use plan** of the area, which may include the formation of new zoning procedures necessary to solve the problems resulting from the combination of land uses and turbojet aircraft operations.

Initial start of the survey will require a noise study by an acoustical engineer, but eventually will include several of the points favored by FAA's suggested airport noise abatement program, such as a recommendation that the Department of Health, Education and Welfare take action to discourage the building of schools and hospitals within the airport noise boundaries outlined by FAA. A major part of the Detroit study will consider the effect jet operations have had on a Romulus Township school located one mile to the west of the airport.

FAA's airport noise abatement planning series is based upon experience with Boeing 707 and DC-8 operations and envisions prohibiting the construction of any residential type dwelling or public assembly buildings closer than a half mile from either side of a jet runway and 3½ mi. from the takeoff end. Restricted zoning contour lines submitted by the agency are based on the outer limits of noise level readings, where noise would decrease below 100 decibels.

In practice, utilization of FAA's plan for an airport with a single 10,000 ft. takeoff runway would create a restricted zoning area measuring at least one mile wide and five miles long. Airports with a greater complex of runways would cover a greater area for restricted zoning.

Favored Land Uses

FAA points out that its suggested restrictions apply only to subdivision developments or such public structures as schools and hospitals, so that a large portion of the land may be used for agricultural, recreational and industrial purposes. Both FAA and FHA favor types of light industry for the area, which could serve as a buffer between the surrounding residential community and airport noise.

New York International Airport has been cited by FHA as an example of its cooperation with FAA desires to halt residential building too close to runways. A few months ago, FHA officials said, an application to construct a 500 home subdivision three quarters of a mile from a runway to the northeast was denied, and a second denial was voted by FHA for a project which would have covered nearly 50 blocks on a site about the same distance from a runway to the northwest. An application for a project of eight-story apartments, located 2½ mi. to the south of the nearest runway, was approved on grounds that planned air conditioning would nullify much of the noise from turbojet takeoffs because windows would be closed much of the time.

PROBLEMS? OR PROFITS?

Route pattern complexities of typical airlines demand a cargo aircraft with the capability of operating over both short and long route segments with excellent economy and earning ability. The Canadair Forty Four will do this for you! It combines the air cargo feeder liner with the long range aircraft to provide a standardized economic fleet unit. The Forty Four will give you profit-making operations, at current rates, over route segments as short as 200 miles and as long as 4,000 miles.

This is the type of flexibility that will answer the many and varied problems confronting airline operators who, because of the growing demands of shippers, are being forced to provide a combination of short, medium and long range air cargo services for the carriage of freight at attractive and competitive tariffs. In this situation, the Canadair Forty Four offers excellent economy and earning ability over the complete range of route structures that must be provided in the collection and distribution of air cargo.

Practical applications of this are found in the short route cargo services that are necessary in the supply and distribution of goods to or from the terminal points of transcontinental and trans-Atlantic services. This is evident between the major cities of the Eastern United States and between the principal points of Europe. These inter-city runs are essential extensions to the long haul trunk service, and with the Forty Four can be handled without a change of aircraft.

The need for this system of short, medium or long range operations will develop through the growing awareness among business establishments that the carriage of articles by air is becoming an essential element in the overall marketing function. This will open up new markets, new transportation requirements, new inter-city services. The Forty Four, with its flexibility of performance, can carry cargo at a profit over the whole distance spectrum—short, medium and long range, and has the airfield performance characteristics to get in and out of 85% of the world's major airports. THESE ARE DECISIVE ADVANTAGES IN FAVOR OF THE FORTY FOUR.

SOME RUNWAY AND PAYLOAD SPECIFICS ON THE FORTY FOUR-D4

1. From runways as short as 6,000 feet, can operate with 70% payload up to stage distances of 3,000 miles.
2. Can operate from 85% of the world's major airports, with due consideration to both runway length and allowable wheel loading.
3. Will earn an operating profit with load factors as low as 30%.
4. Breakeven load factors in the Forty Four represent loss loads on larger proposed equipment.
5. Breakeven load factors on larger proposed equipment represent major profit payloads on the Forty Four.
6. Can operate *non-stop* on the London-New York route with an average annual payload of over 55,000 lbs.

CANADAIR LIMITED, MONTREAL, CANADIAN SUBSIDIARY OF GENERAL DYNAMICS

Political Roadblocks Hamper Jet Airport

New York—Port of New York Authority has been encountering political roadblocks to its proposal to locate a $220 million jet airport in Morris County, N. J. (AW Dec. 21, p. 30).

The Port Authority operation has been under investigation recently by a committee of the U.S. Congress and by a New Jersey senatorial committee. In testimony last month before the state body, executive director Austin Tobin of the Port Authority reiterated the need for another major airport.

But, Tobin said, the Port Authority's job is only to report the results of its findings to the legislatures and governors of the two states, not to make recommendations or statutory proposals. The report will be made in a "definitive" study now scheduled for release about March, 1961.

Another recent development concerning the airport proposal was the offer of 1,000 Morris County acres to the Federal government as a wildlife preserve. The Port Authority will not comment on how this might affect future airport plans.

In a preliminary study the bi-state agency estimated that the need for a fourth airport in the region would become acute by 1965, when, according to the Port Authority, the capacities of La Guardia, New York International and Newark airports would be inadequate to handle the increased traffic. Among 15 sites evaluated, only the Great Swamp location would meet airspace needs, the Port Authority said.

However, residents of the area raised a storm of protest against the possible location of an airport there and have been waging a continuing campaign against it. The Port Authority requires the approval of the New Jersey and New York legislatures to extend its jurisdiction to the area in question, as well as authorization of particular major projects. Both houses of the New Jersey legislature earlier this year soundly vetoed the airport idea by passing resolutions against a Morris County airport.

EAL Offers Enlarged Mexico City Service

New York—Eastern Air Lines will offer tourist class service between New Orleans and Mexico City beginning Oct. 30 in another move to push development of its U.S.-Mexico routes. New York-Mexico City nonstop jet service is expected to begin this year following a recent agreement between Eastern and Aeronaves de Mexico (AW Oct. 3, p. 39).

Like the New York-Mexico route, Eastern's route from New Orleans had been restricted to first class service. Lifting of this restriction from both routes provides the first real opportunity for large-scale development.

Eastern plans to offer tourist service from New Orleans in mixed-configuration Douglas DC-7B equipment. It hopes to attract travelers from other U.S. points on the airline's system to Mexico via the New Orleans gateway.

The tourist-class round trip fare over this route is $111.30, compared with $138.20 first class. Southbound flight time is 3 hr. 25 min.

Firm Seeks World Market for 749As

New York—Company that has bought Eastern Air Lines' fleet of 15 mothballed Lockheed 749A Constellations (AW Sept. 26, p. 34) expects to find a world-wide market for the piston planes.

The 749 Constellation has not been considered an attractive item in the generally depressed used aircraft market. However, Raymond Marshall, president of the Transit Equipment Co. of New York, purchaser of Eastern's 749As, told AVIATION WEEK that these planes should be marketable on a sale, lease or lease-purchase basis. The particular aircraft, he said, are special long-range versions with a number of improvements over the standard 749. They were fitted out for Eastern when that carrier was seeking South American routes.

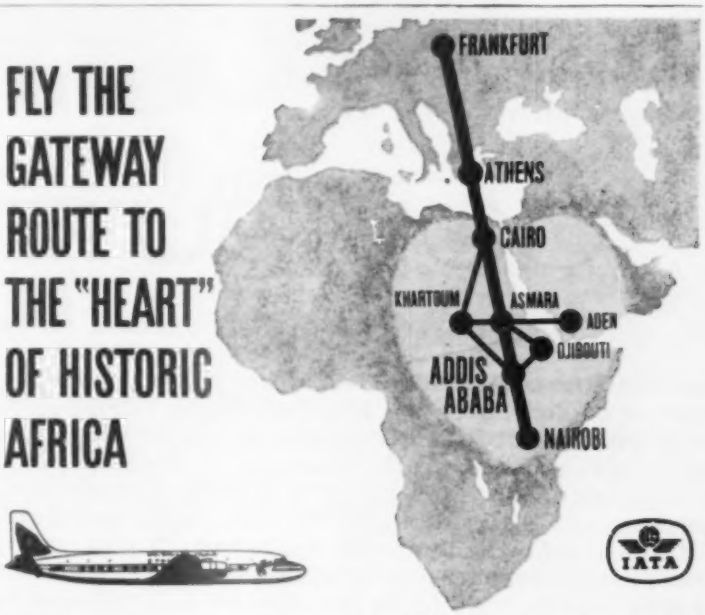
According to Marshall, the planes are equipped with heavy 1049-type landing gear, 5,800-gal. fuel capacity, better air conditioning and other improved accessories. These improvements, Marshall said, should make them attractive to some foreign airlines. Discussions also have been held, he added, with U.S. supplemental carriers engaged in Military Air Transport Service work. The 749As can be fitted with 83 or 62 seats.

Transit Equipment's past experience has included purchase of defunct railroad equipment for dismantling and scrapping or resale. The company was active in used aircraft in the 1930s, Marshall said, but had not participated recently until last year. Recent business has included purchase in Australia of several Douglas DC-6s and subsequent resale.

The planes have been stored at Louisville, Ky. They will be moved to Eastern's Miami facility.

Neither Eastern nor Marshall would reveal the sale price of the used Constellations.

FLY THE GATEWAY ROUTE TO THE "HEART" OF HISTORIC AFRICA



Fly the route of history via Ethiopian Airlines! See Cairo . . . the Red Sea . . . and Ethiopia, Land of the Queen of Sheba. Africa offers today's *greatest business potential, newest travel adventure*. Fly overnight in luxurious DC-6B's from Frankfurt (now 3 flights weekly) to Greece, Egypt, Sudan, Ethiopia and Kenya. Incomparable service.

Visit one of our 5,000 offices in the United States and Europe—YOUR TRAVEL AGENT.

የኢትዮጵያ፡ አየር፡ መንገድ ፡

ETHIOPIAN AIRLINES

THE WONDERLAND ROUTE

COMP'UTENCE

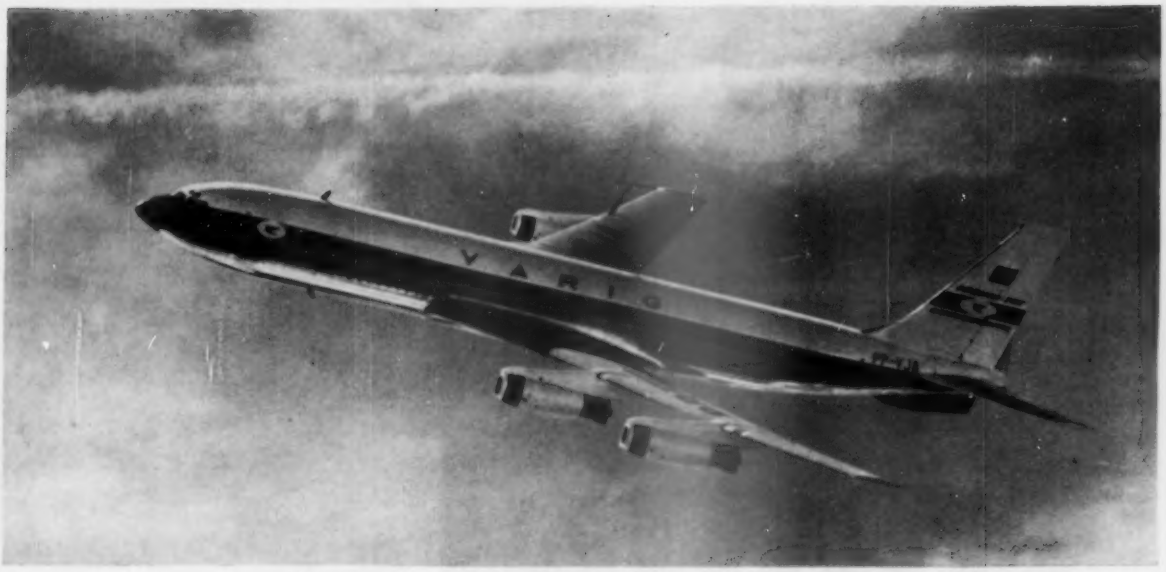
TOTAL COMPETENCE IN COMPUTATION AND DATA PROCESSING—THE BREADTH, THE BRAINS AND THE BACKGROUND

For instance, ALRI: USAF Airborne Long Range Input Program, one more demonstration of Comp'utence—and Burroughs Corporation—throughout the contract team program. **The objective:** a seaward, airborne extension of SAGE via radar-equipped reconnaissance aircraft, processing data in flight and transmitting it through ground receiving sites to central direction centers. **Total competence:** the way Burroughs Corporation, as System Manager, directs the integration of the special skills and facilities of its team*. **Total comp'utence:** the way Burroughs Corporation, also a team member, develops ALRI's miniaturized airborne data processors—reflections of its breadth (R & D through field service), brains (such as the Atlas guidance computers, data processing for Polaris) and background (75 years devoted to computation and data processing).

*Lockheed Aircraft Service, Inc.●Packard Bell Electronics Corporation●Philco Corporation●Military Electronic Computer Division of Burroughs Corporation●Electronic Communications, Inc.●GPL Division of General Precision, Inc. and●AC Spark Plug Division of General Motors Corporation.

Burroughs Corporation

"NEW DIMENSIONS | in computation for military systems"



Varig Operates Two Boeing 707-441s

Varig Airlines of Brazil is operating two Boeing 707-441 Intercontinental turbojet transports on routes connecting New York, Brasilia, Rio de Janeiro, Sao Paulo, Porto Alegre, Montevideo and Buenos Aires. Total of three round trips are flown weekly.

Flying Tiger Lists Fiscal 1960 Net Loss

Flying Tiger Line suffered a net loss from operations of $778,728 during the fiscal year ending June 30, 1960, the airline has reported. Interest and debt expense increased the loss to $1,566,477, with a tax credit and equipment sales bringing the final net loss to $998,668.

During the previous fiscal year, Flying Tiger earned a net of $1,391,366 from operations and special items. Air freight revenues for the later period were up from $13,315,698 to $14,656,314, but military and commercial charter revenues dropped from $21,264,238 to $11,330,700.

The airline attributed its latest results to "chaotic conditions in the military contract field," but said the situation is now being remedied.

Pan American Seeks Stock Deadline Delay

Washington—Pan American World Airways asked the Civil Aeronautics Board last week for a six month extension of the deadline for terminating its stock agreements with National Airlines, citing presently depressed stock market conditions to support its request.

In its July 14 order, the Board directed Pan American and National to return the 400,000 shares of stock mutually exchanged and to cancel an option held by Pan American to purchase up to 250,000 shares of National's stock. The Board gave the airlines 60 days to implement its order.

Pan American told the CAB last week that certain alternatives for disposal of the stock do not now protect the two carriers in light of the recent slump of prices on the New York Stock Exchange.

Pan American said: "If the parties had to act now, they would have no alternative but to return the shares, which would have an adverse effect on the credit of both parties as it would deprive them of additional equity which resulted from the issuance of the shares." Pan American then asked the Board to approve a six month extension, instead of a 90 day extension recommended by CAB's Bureau Counsel.

French Lines Extend African Jet Service

Paris—French carriers have extended jet service from Paris throughout West and South African areas.

Air France is using Boeing 707s while two private carriers, Union Aeromaritime de Transport (UAT) and Transports Aeriens Intercontinentaux (TAI), are using Douglas DC-8s. UAT, which holds the only French rights to South Africa, now offers DC-8 service between Paris and Johannesburg, South Africa.

Flight time between these two points has been reduced to 12 hr. instead of 24 hr. Paris-Brazzaville, one of the busiest routes, now is covered in just over 7 hr. instead of 14.

In addition, Air France and UAT, in order to meet the air transport needs of interior African lines, have jointly set up a new company, Air Africa. Latter outfit will work with the newly independent French African nations in developing local air service.

Board Goes to Court In ATA Probe Fight

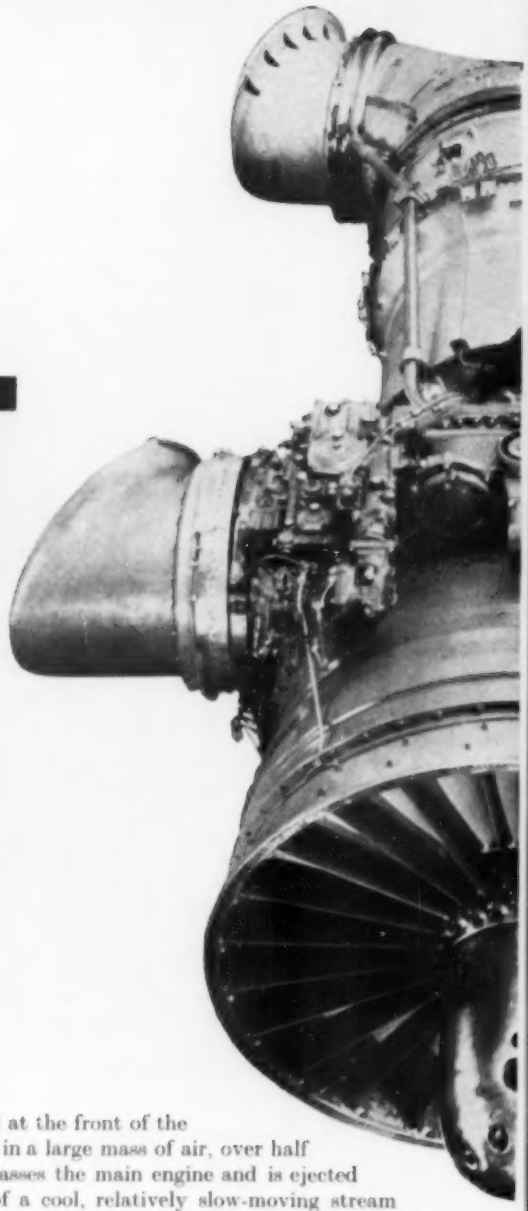
Washington – Civil Aeronautics Board has asked the U. S. District Court for help in its battle with Air Transport Assn. over documents the Board seeks in its investigation of ATA.

CAB asked the court to force ATA to surrender certain documents the Board has ordered produced, charging ATA has consistently refused to make them available. CAB told the court that after an investigation into its operations had begun, ATA "adopted tactics of obstruction and delay" in withholding 111 documents from inspection by CAB.

Board said it had served a subpoena on the ATA which the association answered by requesting that the Board quash the subpoena. The CAB refused to do this and ordered ATA President Stuart G. Tipton to produce the records on June 16. ATA then filed for reconsideration of the order to comply with the subpoena, which was also denied.

CAB has asked the court to compel Tipton to appear before CAB Chief Examiner F. W. Brown and produce the records required by the subpoena or compel the ATA to make the records and documents available for inspection at its offices in Washington.

LIFT AND THRUST FROM ONE ENGINE



A single power source for VTOL and STOL aircraft. The new Bristol Siddeley BS 53 high-ratio turbofan represents a major engineering breakthrough in the field of VTOL and STOL aircraft propulsion because it provides the airframe designer with a single power source *for all conditions of flight.*

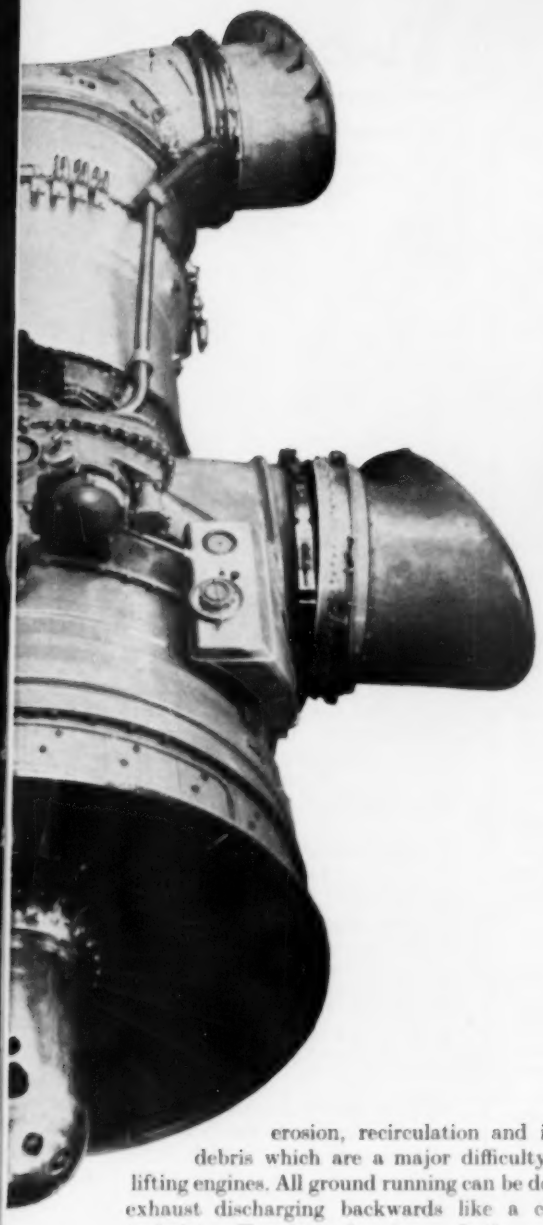
VTOL, STOL and normal take-off capability. The most revolutionary feature of this unique engine is that the thrust can be evenly applied around the centre of gravity through four movable nozzles which are directed downwards for lift, backwards for thrust, forwards for braking in flight, or in any intermediate direction. This makes possible, for the first time, the design of single or multi-engined aircraft in which the total installed thrust is available for vertical or short take-off with a normal payload or for conventional take-off with a large overload.

High cold-flow ratio, high thrust, low fuel consumption. The BS 53 is a high-thrust engine and the basic design concept which makes its versatile performance possible is a high cold-flow ratio.

A fan, located at the front of the engine, draws in a large mass of air, over half of which by-passes the main engine and is ejected in the form of a cool, relatively slow-moving stream through the two forward nozzles. The remainder passes through the gas generator and supplies thrust to the two rear nozzles. This arrangement greatly improves the Froude efficiency and gives the BS 53 a higher thrust/weight ratio, a lower specific fuel consumption and a lower noise level than any turbojet of comparable power in existence today.

Conventional installation, operational simplicity. The BS 53 is installed normally, with forward-facing intakes and the majority of its components are based on well-known principles already proved in service. These factors make for operational simplicity, easier maintenance, greater reliability.

Reduced problems of ground erosion and recirculation. Because the velocity and temperature of its jet effluxes are low, the BS 53 minimises the problems of ground



THE REVOLUTIONARY
BS 53
TURBOFAN

erosion, recirculation and ingestion of debris which are a major difficulty with fixed lifting engines. All ground running can be done with the exhaust discharging backwards like a conventional turbojet. Taxying also is perfectly normal, and at take-off a short forward roll before the nozzles are deflected downwards ensures that all debris is left behind. As a result, the BS 53 does not require prepared sites and is *independent of all fixed ground installations.*

Selected for the world's first VTOL fighter. The Bristol Siddeley BS 53 has received the support of the Mutual Weapons Development Programme for NATO, and has already been selected for the world's first fixed-wing, aircraft designed for operational service with V/STOL capability—the Hawker P 1127. Although this remarkable engine was primarily designed for this type of aircraft, it is equally suitable for any single or multi-engined, subsonic or supersonic aircraft which requires VTOL or STOL capability.

...ANOTHER ENGINEERING ADVANCE
BY BRISTOL SIDDELEY

BRISTOL SIDDELEY ENGINES LIMITED

Bristol Aero-Industries Limited, 200 International Aviation Building, Montreal 3, Canada. Tel.: University 6-5471

AIRLINE OBSERVER

► De Havilland is developing a new version of its Trident tri-jet short haul airliner designed specifically for the U.S and Canadian market. Trident Series 2 design grosses 140,000 lb. and features an 8-ft. extension to the fuselage allowing up to 120 passengers in six-abreast seating, a reduction in wing sweepback from 35 to 30 deg., increased fuel capacity to permit Chicago-San Francisco nonstop flights on U.S. routes and Toronto-Calgary nonstop in Canada. Engines would be either Rolls-Royce Conway RB.141 bypass jets or Pratt & Whitney JT3D turbofans. De Havilland now has its initial Trident 1 more than half finished at its Hatfield plant with three other aircraft under construction with production type tooling.

► Armstrong Whitworth is planning a VTOL version of its Argosy freighter for military transport use (AW Sept. 12, p. 33). Two batteries of Rolls-Royce jet lift engines in pods would replace the Dart turboprops in the outboard nacelles and Tyne turboprops would replace the Darts in the inboard nacelles. Lift engine pods would probably mount 20 Rolls RB.162s in each pod.

► British government policy decision has been made to continue development of the Fairey Rotodyne VTOL transport, now transferred to the merged Westland helicopter combine, and to abandon further development of the turbine-powered Westland Westminster based on the Sikorsky single rotor design. Neither of the Rotodyne's customers—British European Airways and New York Airways—are over-enthusiastic about the Rotodyne's transport prospects. BEA is worried about the noise problem in metropolitan London while New York Airways is disappointed at the negligible technical development progress recorded during the past three years of Rotodyne history. Considerable aerodynamic and structural changes are in prospect for the commercial version of the Rotodyne.

► Deliveries of the Vickers Vanguard turboprop transport to Trans-Canada Air Lines are still being delayed by Rolls-Royce Tyne engine deliveries. Rolls says it has found a fix for the turbine disk failures that occurred in the Tyne (AW July 4, p. 45) but is not yet delivering production engines incorporating it for the Vanguard.

► Watch for a Federal Aviation Agency regulation requiring third pilots to undergo the same training as certificated copilots on airlines which permit third crew members to operate aircraft. No federal regulation governing basic requirements for third pilots now exists. The ruling is not expected to change company rules of some carriers—American, for example—which prohibit third pilots from handling controls under any circumstances.

► United Air Lines will offer for sale the 41 Viscounts it will acquire if the United-Capital merger materializes, although it will keep the fleet in scheduled service as long as it is part of the merged carrier's aircraft inventory.

► Restricted airspace within the continental U.S. and possessions has continued to decline under Federal Aviation Agency's policy of handling all applications for controlled airspace as rule-making proceedings. Last month's low of 124,920 sq. mi. represents a 15% decrease from the 143,678 sq. mi. of airspace restricted in June, 1959 (AW Aug. 8, p. 42).

► British Overseas Airways Corp. will withdraw its de Havilland Comet 4 turbojet transports from the North Atlantic route Oct. 15. BOAC's transatlantic jet service will be conducted exclusively by Boeing 707 Intercontinentals powered by Rolls-Royce Conway bypass engines. Comets will be diverted to Far East and South American routes.

► India and U.S. opened talks last week on amendments to the bilateral air transport pact between the two countries. Chief issue at stake is restriction on traffic capacity.

► International Air Transport Assn. is running into increasing difficulty in locating adequate hotel meeting space for its traffic conference and now feels that it will be forced to lease convention halls for the annual meetings of the conference.

SHORTLINES

► **Air Transport Assn.** reports U.S. certificated airlines' freight traffic rose 9.2% during the first seven months of 1960 over the same period last year. Domestic and international air freight ton-miles were 353,434,000 for the seven months ending July 31, against 323,788,000 for the 1959 period.

► **Allegheny Airlines** will issue a monthly, 382-page guide containing the carrier's routes and schedules as a quick reference to passengers.

► **Capital Airlines** has asked the Civil Aeronautics Board for permission to begin nonstop "air bus" service between Pittsburgh and Miami at a one-way fare of $40, effective Oct. 31. The airline said the new tariff represents a 26% reduction from regular day air coach fares.

► **Delta Air Lines'** proposal to increase certain air coach fares on its system has been suspended until Dec. 13 pending investigation by the Civil Aeronautics Board. The increases would cover several routes on the southern part of Delta's system.

► **Pacific Northern** and Alaska Airlines have been denied local service authority between Portland and Seattle/Tacoma, on flights from Portland to Alaska, by the Civil Aeronautics Board. In its decision, the CAB said local service between the two northwest points was adequate as provided by West Coast Airlines, Pacific Airlines and Northwest Airlines.

► **Pan American World Airways** has received Civil Aeronautics Board permission to suspend until May 31, 1961, service on its polar route from Los Angeles/San Francisco to Paris. Pan American will continue to operate the route from the West Coast to London with connecting services to Paris.

► **Riddle Airlines** and Pan American World Airways proposed decreases in rates on certain commodities flown between New York and points in Puerto Rico have been suspended by the Civil Aeronautics Board for investigation. Pan American's tariff was filed for "defensive purposes," and the airline told the Board it is prepared to withdraw if the Board dismisses Riddle's action. Pan American, Trans Caribbean Airlines and Allied Air Freight International Corp. filed complaints contending the rates would be uneconomical. The proceeding is the New York-San Juan Cargo Rates Investigation.

Shown above is a modified version of the AN/GJQ-9

AIR FORCE SELECTS BENDIX TAPE-CONTROLLED TEST UNIT FOR SKYBOLT MISSILE CHECKOUT

The Air Force Type AN/GJQ-9 Checkout Sequence Programming Set—a universal, automatic programmer-comparator—is now in quantity production at Bendix. It is designed for automatic GO, NO-GO checkout of the GAM-87A Skybolt, an air-launched hypersonic ballistic missile manufactured by Douglas Aircraft Company. In addition, the device—capable of making as many as 100,000 test evaluations—is adaptable to a wide range of other programmed, sequential testing and monitoring operations.

Some functions of the AN/GJQ-9 are:

- **Selection of stimuli control channels for application to system under test.**
- **Regulation of program continuation in accord with measurement and evaluation results, or holding program conditions as directed by tape intelligence and selected operating mode.**
- **Operation of visual and printed read-out devices to indicate test data in accord with selected mode of operation.**

BENDIX SUPPORT EQUIPMENT—TETERBORO concentrates on developing electronic and electromechanical equipment. Systems produced besides checkout devices include adaption equipment, training devices and simulators, and monitoring equipment.

90-MINUTE CONVAIR B-58 CHECKOUT. Still another example of proved Bendix support capabilities is this flight-line computer-on-wheels. Previous flight control system checkout procedures required the time of two men for three days in making *spot* static tests. This automatic Bendix equipment makes 750 static and dynamic tests in 1½ hours. The B-58 flight control system is manufactured by Eclipse-Pioneer Division of The Bendix Corporation.

ANOTHER BENDIX FACILITY: Bendix Support Equipment—South Bend, Indiana, specializes in hydraulic, pneumatic, and mechanical equipment, including missile launchers, erection equipment, power generating and supply systems, and many other related devices.

For answers to your electronic and electromechanical support problems, contact . . .

THE Bendix CORPORATION

BENDIX SUPPORT EQUIPMENT

TETERBORO, N. J.

THE ACKNOWLEDGED LEADER IN ANALOG COMPUTER DESIGN

REAC®

offers a new high frequency, solid state Electronic Multiplier:

- Static accuracy comparable to the best time division multiplier designs
- Dynamic response far in excess of any other multiplier
- Factory calibrated — requires no field adjustment
- Solid state shaping networks
- Static Multiplier accuracy — to 0.05%

For complete specifications, write for Data File No. 710.

MULTIPLIER CONSOLE

1. Eight Independent Products.
2. Expandable to 16 Products with adapter kit.
3. Adequate power for expansion to 16 products.
4. Operational Amplifier for each product.
5. Amplifier Balance Meter.
6. Standard Rack Mounting.

Qualified engineers seeking rewarding opportunities in these advanced fields are invited to get in touch with us.

Reeves INSTRUMENT CORPORATION

REEVES INSTRUMENT CORPORATION

A Subsidiary of Dynamics Corporation of America
Roosevelt Field, Garden City, New York

Oxygen Test Studied as Astronaut Check

By Cecil Brownlow

Zurich—Relatively simple, inexpensive method of determining the resistance capabilities of space vehicle crew members to most of the stresses they may encounter was proposed here at the Second International Congress of the International Council of the Aeronautical Sciences.

Terming the extensive tests employed in the selection of National Aeronautics and Space Administration Project Mercury candidates "complicated, time wasting" and "expensive," West German bio-scientist Dr. Siegfried Ruff believes that an individual's resistance to most, if not all, stresses can be determined by a single experiment—subjecting him to an insufficient oxygen supply.

Insufficient oxygen, Dr. Ruff says, "serves to establish in considerable measure the adaptability of the body and, therefore, its capacity to resist."

Dr. Ruff—pointing out that a person's resistance factor can change day by day, depending upon his immediate experiences and physical condition—contends that a major advantage of his system is that it would permit an accurate double check of a crew member on the eve of his proposed flight. Average times needed to conduct the tests are between 30 and 45 min.

Oxygen Starvation

Professor of the Institut fur Flugmedizin, Deutsche Versuchsanstalt fur Luftfahrt (Institute for Flight Medicine, German Center for Air Research) at Bad Godesberg, Dr. Ruff says that tests of "thousands" of subjects by his group seem to have effectively proved the validity of the oxygen starvation theory.

Tests were conducted in a compression chamber set at an altitude of approximately 25,000 ft., and the candidates subjected to a variant of the "square hole and round peg" routine.

Test subjects were given a series of balls of varying diameters and told to drop them into the corresponding holes placed around a revolving drum. The holes, in turn, opened one after another for a period of 2 sec. each. Thirty balls per minute in their proper slots was considered perfect for purposes of the tests. At sea level, Dr. Ruff and his associates found that almost all test subjects, regardless of age, could perform the routine satisfactorily after 10-to-12 min. practice.

Candidates taking the test were divided into two broad categories—A, which showed a rapid decline in performance under oxygen starvation, and B, which demonstrated a slower drop in performance, a factor interpreted by Dr. Ruff as a sign of good adaptability to changing conditions.

System Disturbances

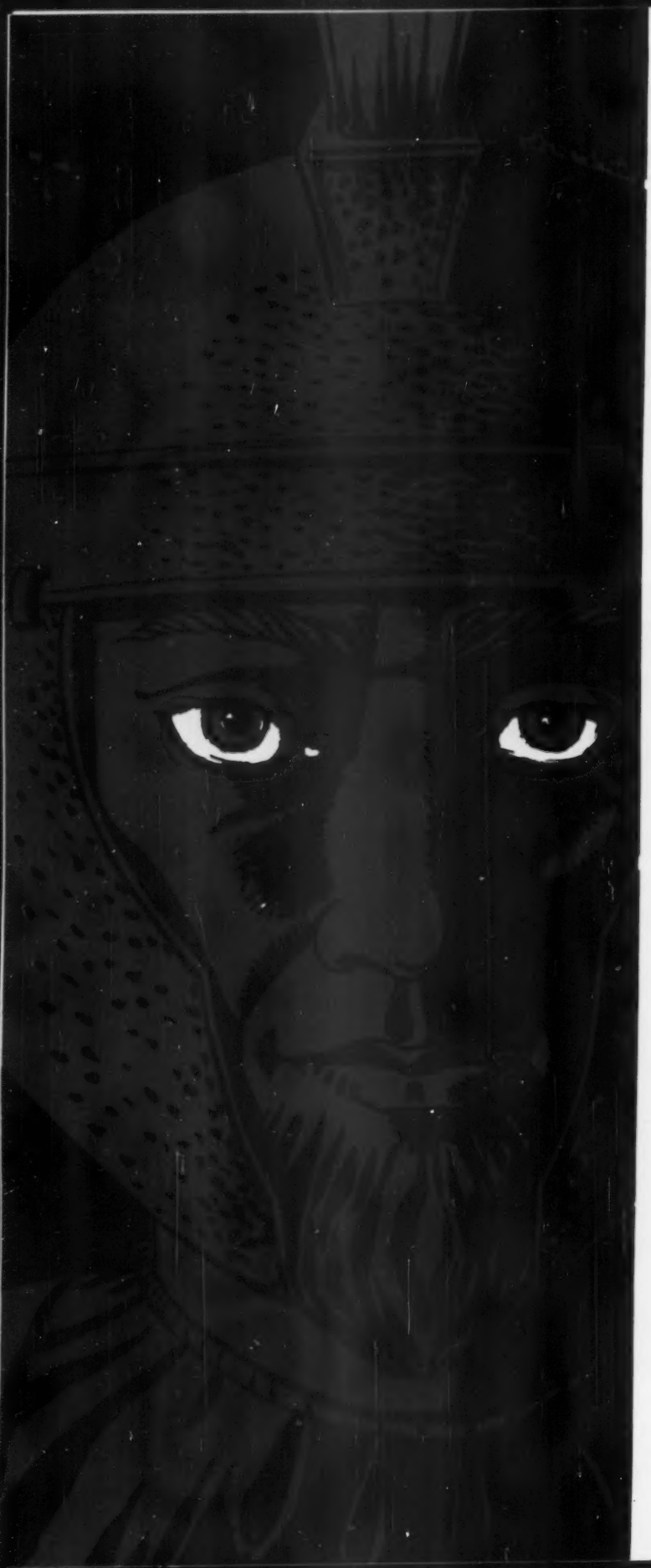
Over-all results, according to Dr. Ruff, tend to show that the capacity to resist generally increases with age until a person reaches 40 but is also statistically related to disturbances of the physiological systems. No differences could be observed between the two groups in a number of factors normally used in determining a person's resistance to oxygen starvation, including circulation and respiration.

Need for a rapid double check system almost immediately prior to space flight was emphasized by Dr. Ruff who gave several examples of varying resistance to stress. In one instance, a pilot showed a marked decline in performance when subjected to insufficient oxygen after recovery from a prolonged illness, although his regular medical examination had failed to indicate any noticeable deviations from the norm. Six weeks later, the pilot's resistance had returned to its pre-illness level.

In another, a test subject given insuf-

Centaur Liquid Hydrogen Engine Delivered

First LR-115 liquid hydrogen engine has been shipped to Convair Astronautics for test and integration with Centaur launch vehicle stage Convair is developing for NASA. Centaur will use two 15,000-lb.-thrust stop-start Pratt & Whitney LR-115s.



VIGILANCE

in three dimensions

Eyes can see in three dimensions . . . instantly. Westinghouse has perfected this vital ability in radar to meet defense needs for instantaneous target information.

This Westinghouse technique combines search and height finding in *one* radar. Unlike other systems, the Westinghouse technique offers true 3-D capability. As each target paints on the PPI, its height is immediately available in *real time.*

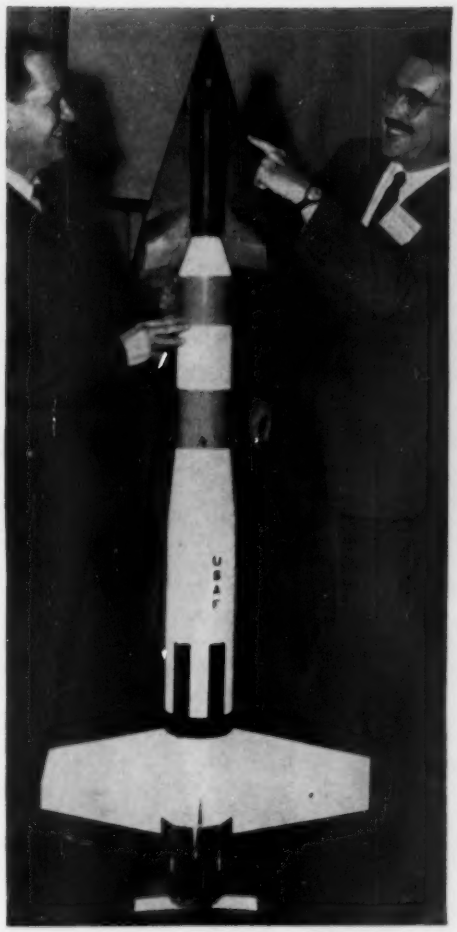
Developed for the U.S. Air Force, this technique has been successfully employed in both tactical and air defense radars currently in production at the Electronics Division.

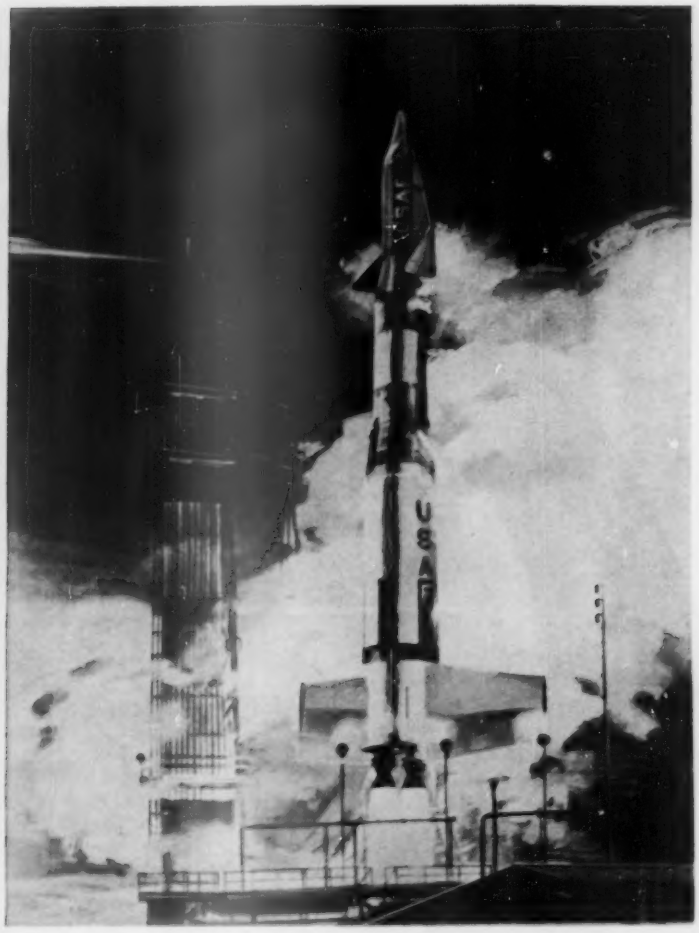
One example is the new, truly 3-dimensional AN/TPS-27 tactical radar. This Westinghouse radar requires little or no site preparation, and successfully combines high data rate and mobility with fixed station performance. Here is another demonstration of capabilities for defense.
You can be sure . . . if it's Westinghouse.

Westinghouse Electric Corporation Defense Products Group, 1000 Connecticut Avenue, N.W., Washington 6, D. C.

Westinghouse

J-02321





Model Shows Dyna-Soar on Modified Titan Booster

Model of Dyna-Soar boost-glide space vehicle mounted on modified Titan booster is at left; drawing at right is artist's conception of launching. Lt. Gen. Roscoe C. Wilson, USAF deputy chief of staff—development, is at left in left photo; George H. Stone, Boeing Dyna-Soar program manager, is at right. Note large stabilizer fins on booster.

ficient oxygen after a strenuous training course, which provided little opportunity for long periods of uninterrupted sleep, showed a very poor resistance. Three months later, after his schedule had returned to normal, his resistance to oxygen starvation was described as "particularly high."

Dr. Ruff, in supporting his theory, points out that reactions of organisms under stress are triggered by the pituitary gland and the cortex of the suprarenal gland.

These reactions, "which are far from being understood in all their details," adapt the particular organism to the relevant stresses—temperature, intoxicants, bacteria, etc.

Since there was no appreciable difference in circulation and respiration under oxygen starvation between the resistant and non-resistant groups tested by the institute, Dr. Ruff assumed that the explanation must lie with the reactions on the pituitary gland and the cortex of the suprarenal gland.

After activation of the cortex of the suprarenal gland and emission of its hormones, the quantity of red coloring matter in the blood stream decreases, and here Dr. Ruff found a substantial difference between the two groups. He told the ICAS:

"When the decrease is compared between categories A and B after oxygen starvation, it is found that significant differences arise between them if the time of stress is constant for all those tested. The B type, i.e. more resistant, candidates are subject to a slighter decrease of red coloring matter and have a more rapid regeneration. This must be connected with the activation of the cortex of the suprarenal gland. . . ."

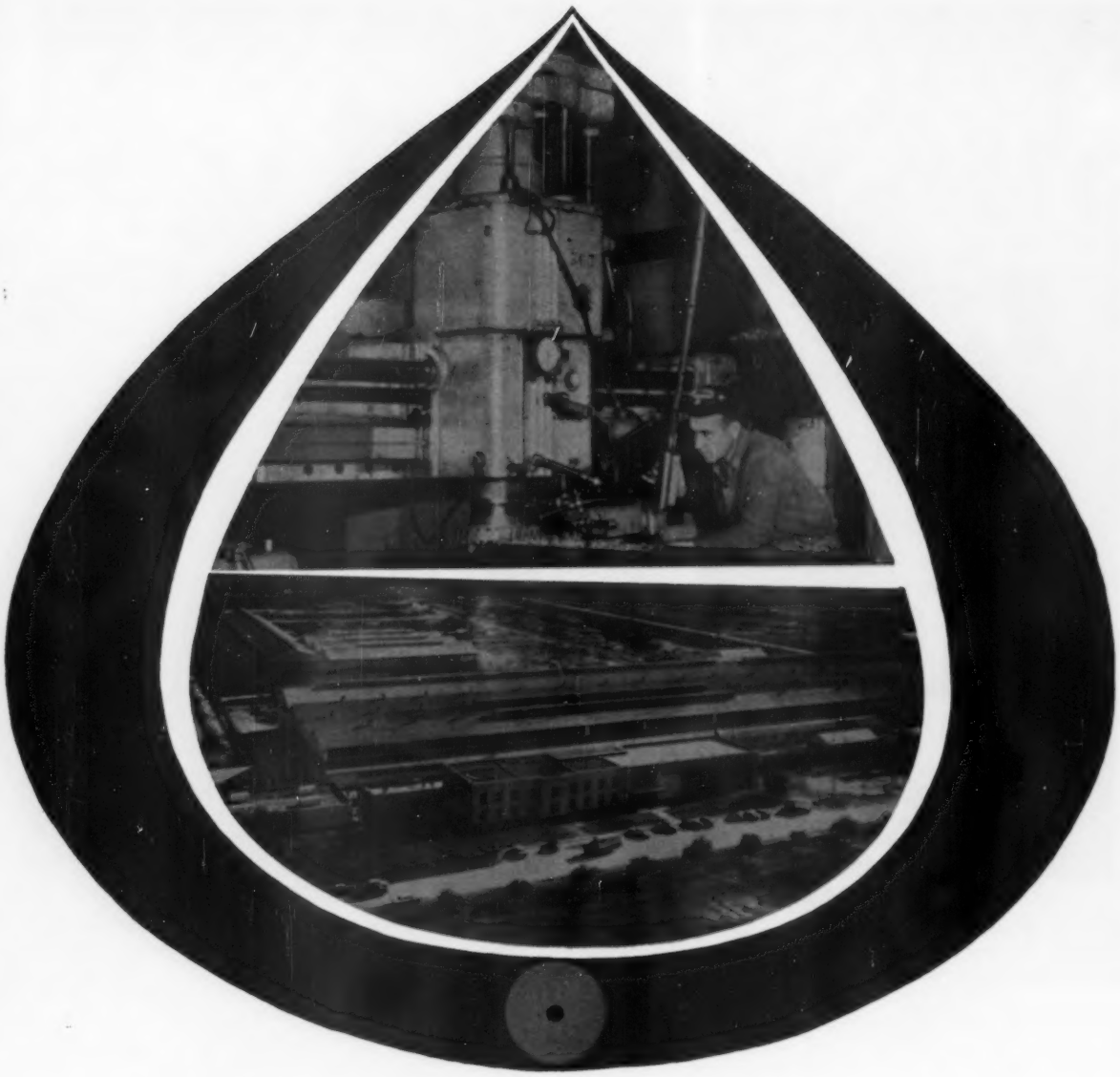
Considering the different reactions of the cortex of the suprarenal gland under oxygen starvation in groups A and B, Dr. Ruff concludes that "resistance under lack of oxygen is related to other unspecific stresses." He said examination of the same persons under conditions of heat, cold and oxygen starvation "has so far confirmed this theory. . . . Although subject to other stresses, the candidates remain in the same categories."

On the basis on these results, Dr. Ruff concludes that, "insofar as their selection depends on endurance under stress, it would not be necessary to subject all crew candidates for unconventional aircraft to the widest possible range of resistance tests.

"Oxygen starvation suffices as a test of endurance. Its effect on the performance of the human body can be quickly and objectively established, and, for the candidate himself, this test is much less unpleasant than heat or cold."

In another report, R. B. Hildebrand, chief of advanced systems research at Boeing Airplane Co.'s Aero-Space Division, presented an analysis of the problems of manned re-entry at speeds of greater than 26,000 fps., with emphasis upon the lunar return mission.

For re-entry of a lunar mission, Hildebrand considered two possible trajec-



VERSATILE METAL FABRICATION geared to the Southwestern space-age industries

Youngstown's Continental-Emsco Division has over 77 acres of metal fabricating facilities . . 336,505 square feet under roof, convenient to the many Southwestern electronics and air frame manufacturers. This fully integrated plant places at your disposal a competent, creative engineering and R&D staff; batteries of precision gear cutting machines; flexible equipment for milling, turning and boring and spacious bays for all types of metal fabrication and assembly. Plant quality control qualifies for MIL-Q-9858. Put this capable plant to work for faster deliveries . . higher quality . . lower cost. Write, wire or call today.

DF-002

METAL FABRICATORS FOR INDUSTRY

CONTINENTAL-EMSCO COMPANY

GENERAL OFFICES: DALLAS, TEXAS • P. O. BOX 359 • PLANTS: HOUSTON, GARLAND, TEXAS; PASADENA, CALIFORNIA

A DIVISION OF THE YOUNGSTOWN SHEET AND TUBE COMPANY

tories—direct, in which the vehicle approaches the earth in the same direction as the earth's rotation; and retrograde, in which re-entry is made in a direction opposite the earth's rotation.

Two Trajectories

He attributed these characteristics to the two trajectories:

- **Direct return flight** at lunar launch: velocity, 9,000 fps.; launch angle, 39 deg.; flight time, 2.25 days.
- **Retrograde return flight** at lunar launch: velocity, 9,000 fps.; launch angle, 24 deg.; flight time, 2.70 days.
- **Direct return earth re-entry:** entry angle sensitivity to launch velocity, 0.8 fps.; inertial velocity, 36,200 fps.; relative velocity, 34,600 fps.
- **Retrograde return earth re-entry:** entry angle sensitivity to launch velocity, 1.2 fps.; inertial velocity, 36,200 fps.; relative velocity, 37,740 fps.

Hildebrand concluded that lifting entries of one form or another probably will be needed to reduce accelerations and broaden the bounds of the re-entry corridor, which is determined on the one extreme by the overshoot or skip limit, on the other by the aerodynamic heating and/or acceleration limit.

Third International Congress of the International Council of the Aeronautical Sciences is scheduled to be held in Stockholm next year during the week of Sept. 10, following the 22nd Flying Display of the Society of British Aircraft Constructors at Farnborough.

Czech Centrifuge Turns at 6 Million rpm.

Washington — Czechoslovakia has built an ultra-high speed centrifuge which turns at 6 million rpm. and will be an important tool in basic research in particle physics.

The new centrifuge, which has been exhibited in Moscow according to the Soviet magazine The Economic Gazette, has its vertical rotor magnetically suspended and stabilized by an electronic system. An electric current of 100 kc. frequency drives the rotor, and it turns in a vacuum chamber with a pressure on the order of 10^{-4} M Hg.

Gravity field created on the periphery of the tiny cylindrical rotor of this machine, which is designated Type UC-2, is high enough to overcome the bond strength of the strongest adhesives and galvanic coatings. It also can be used to study the structure of unstable elements, the separation of neutrons and the mechanism of the enrichment of isotopes. Research work performed with this machine would be of direct benefit to development work on nuclear fuels, high temperature materials for aircraft and space vehicle nose cones, and chemical fuels.

Two Systems Aided Sputnik V Recovery

Moscow—Two separate deceleration systems were used during the recovery from orbit of the three-piece Sputnik V satellite which carried two dogs and other test specimens (AW Aug. 29, p. 28). The first Russian-manned satellite is scheduled to use these two deceleration systems, along with the recovery parachutes used on Sputnik V.

Re-entry and recovery sequence of the Sputnik V recoverable satellite consists of four major operations:

- **Retrorocket is fired** to decelerate the entire five ton vehicle and bring it down out of orbit.
- **Recoverable cabin** protected by a heat shield is separated from the non-recoverable instrument section immediately after the retrorockets stop firing.
- **Second deceleration** system then is activated to further slow the recoverable cabin. Operation of this system has not been detailed by the Soviets. Retrorockets or atmospheric drag brakes could be employed. This deceleration system is used from an altitude of about 200 mi. down to about 4 mi. or around 20,000 ft. Maximum loading during the deceleration is 10g according to the Russians, and the ground distance covered is a little less than 7,000 mi.
- **Capsule containing** the living occupants of Sputnik V was ejected from the recoverable cabin between 20,000 and 25,000 ft. and both sections then were lowered to the ground by parachutes. The descent rate of the cabin is specified at 32.8 fps. and that of the occupant's capsule is reported to be in the neighborhood of 23 fps. or lower. Parachute descent rate called for on the U.S. Project Mercury capsule is 30 fps.

The last portion of the Sputnik V recovery sequence was actually included in the design as a reserve system to be used if the parachute on the recoverable cabin failed to open. Normally the occupant's capsule would not be ejected from the cabin.

Two major advantages are apparent in the procedure of designing a recoverable satellite in two main pieces. First, the weight of the heat shield necessary to protect the cabin during re-entry is reduced considerably by discarding the weight of the instrumentation and power supply before re-entry begins. Second, the size and weight of the second deceleration system and the recovery parachutes is substantially reduced because a major portion of the satellite's weight is discarded before they are employed.

During the re-entry, the attitude of the Sputnik V recoverable cabin was controlled by a system of gas nozzles actuated by a stabilization system.

GEORGE COOPER PUBLICATIONS
one of the leading producers of technical, commercial, and military publications.

By offering a really complete service, from highly technical writing and illustration to creative design for proposals and brochures, George Cooper Publications is regarded by customers throughout the country as an invaluable asset to their firms' programming. Are you and your firm having technical publication problems? Give us the opportunity to show you how we can solve them and save you money at the same time. Write now for our free brochure.

GC

GEORGE COOPER PUBLICATIONS, INC.
11907 Wilshire Blvd., W. Los Angeles, Calif.
GRanite 8-0381

☐ Send Brochure ☐ Have Representative Call
NAME _____
TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____

Kodak
TRADE MARK

Kodak and the eye

In the course of maintaining ourselves as the world's best-equipped organization in everything related to photography, we have gone down some interesting bypaths.

One of these paths, some years ago, led to the production of millions of reflector buttons like this.

They're very simple optical devices that turn a light ray back on itself regardless of the direction it came from. You once saw them everywhere forming the letters on highway markers. Though very cheap, their optical quality was amazingly high. (Too high, in fact. They tended to return the rays more to the headlights themselves than to where the drivers' eyes were. We fixed that.) After a few years of vast success in this market, we were knocked out of it by a better idea—microscopic beadlets that did the same thing while dispersed in a medium that could be applied like paint. That's what is seen on the highways today.

The world moves on. We are back on the subject of sending light to the eye, but with a sophistication far beyond that required for night-bright signs or animated advertising displays.

This comes about from our involvement in problems of picking up visual information from places where a human eye cannot or should not go. In such problems, it is not worth calling upon us if plain closed-circuit TV cameras will do. We step in when it becomes desirable to broaden the talents of the simple TV camera tube with precision optical devices and with precision mechanical devices to manipulate the optical devices. As it happens, the first TV bombsight was Kodak's and so was the first TV gunsight that may well promote the brave tail gunner on a bomber to an honorable place in the military museum where they show the horse-mounted knight in shining armor.

The inventions required were made by Kodak at its own expense and then further elaborated by Kodak to create this television eyeball on the underside of North American's A3J "Vigilante" Attack Bomber by which the occupants look around at their external environment.

But television eyeballs must eventually feed into human eyeballs. There is more to be done than putting

the image on the face of a cathode-ray tube. Space is at a premium. Small tube faces need optical magnification. Magnification loses light.

Kodak has found a way to direct this precious light into the eyes of the watchers and not waste it elsewhere. Brightness is several hundredfold improved over the situation where the light is simply thrown out from the projection screen into the room in hope that somewhere a pair of eyes will catch some of it. *The smaller the space from which the eyes may watch, the more the gain in light.*

Below is a demonstration, by the engineers who worked it out, of a screen material which can be given the ideal reflection characteristics wanted in any given projection situation. It permits the shape and size of the audience space to be exactly specified in relation to the location of the projector. It permits several audience spaces simultaneously from several different projectors, each audience seeing a different image on the single screen. Nobody's image is washed out by ambient light or somebody else's image. The entire viewing situation is preset by the microtexture of the projection screen and its curvature. Very nice to have in a busy, cramped operations office whether on the ground or riding through free space or hydrospace.

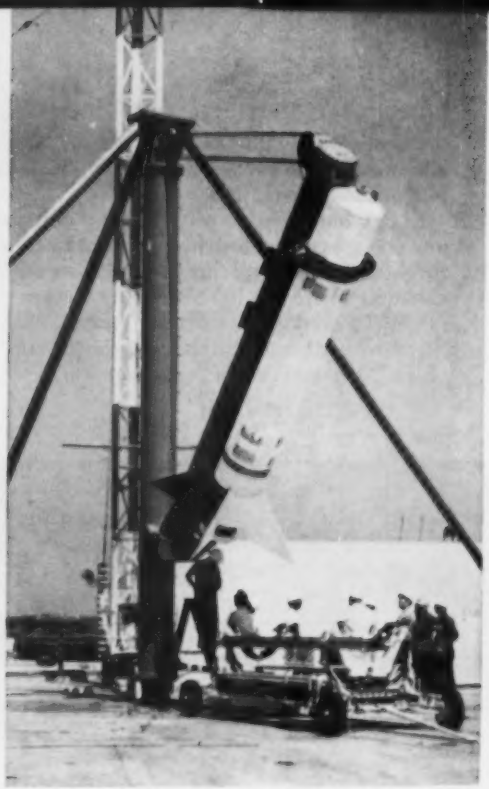
PHOTOGRAPHY
OPTICS
ELECTRONICS
MECHANICS
INFRARED

For a booklet that succinctly summarizes our work in co-ordinating these fields, write Government Contracts Department

You don't have to search for people who can put together such a system and make it work. They are available at Kodak now, a potent *force in being* for significant accomplishment in the sparsely settled country between optics and electronic engineering.

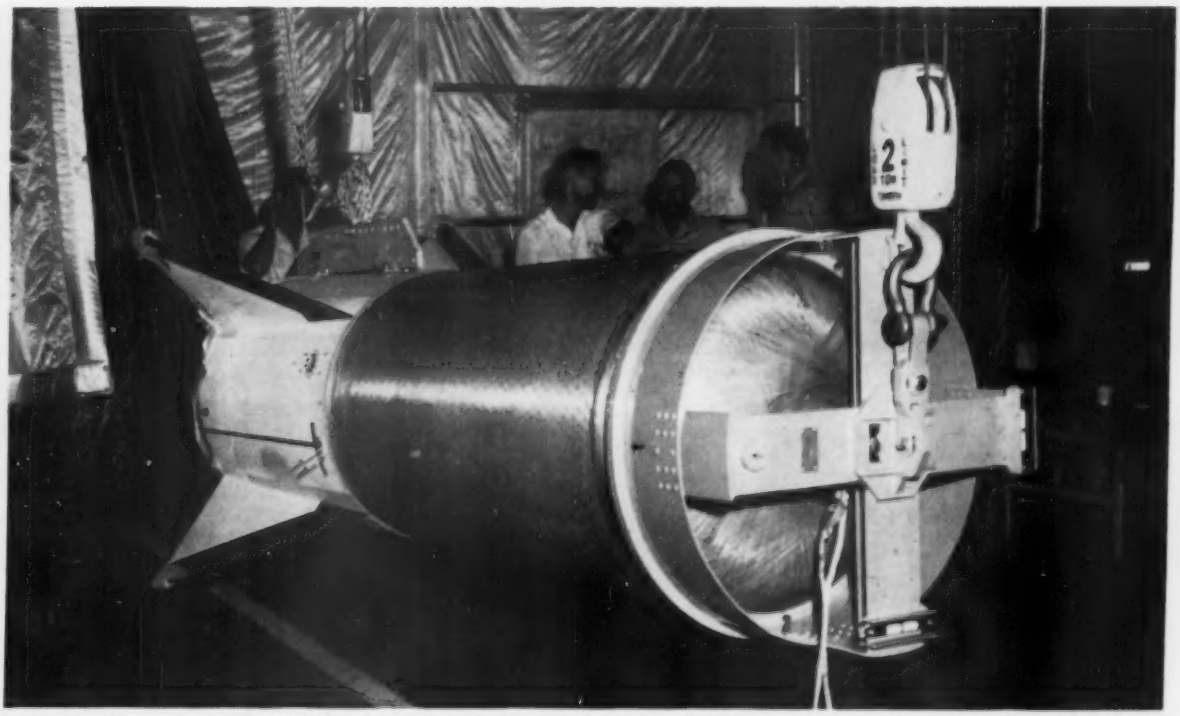
Shall we meet and talk of the relation between our capabilities and your needs?

EASTMAN KODAK COMPANY, *Apparatus and Optical Division,* Rochester 4, N. Y.

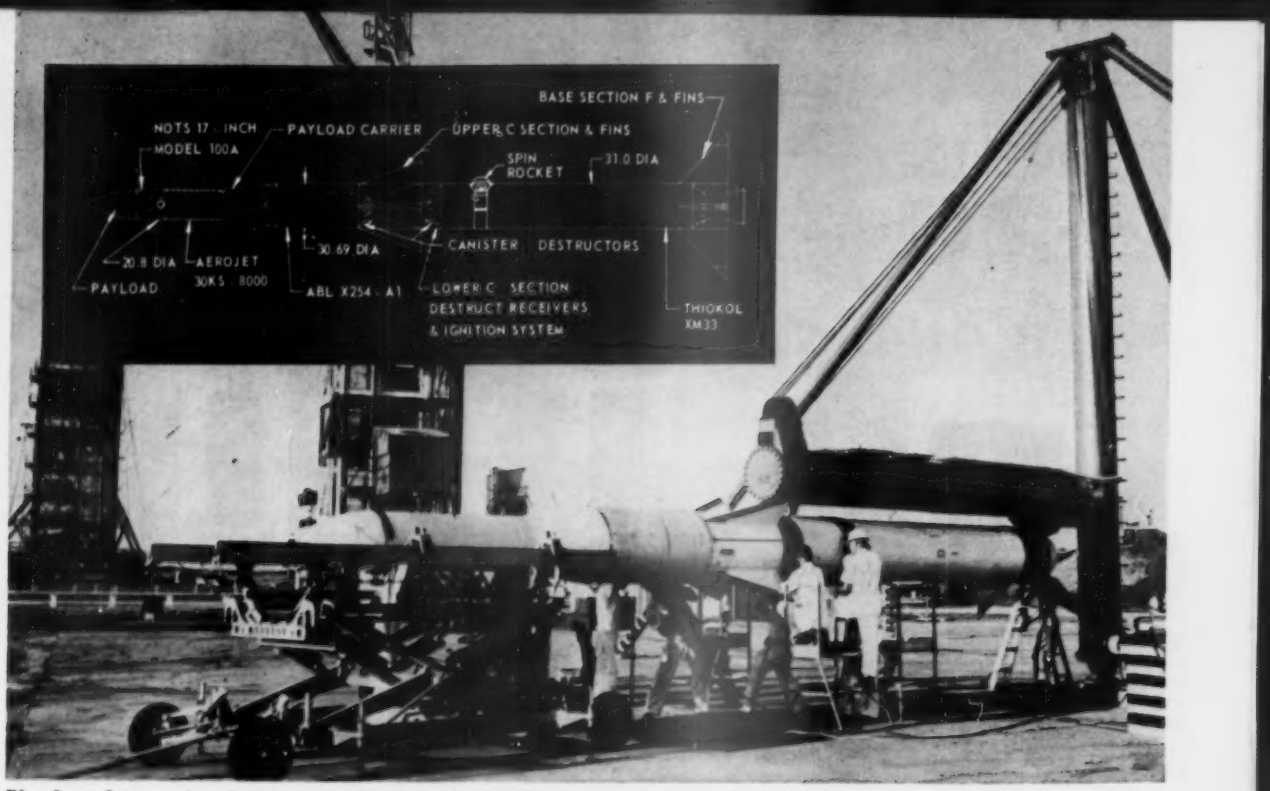


First stage of Scout vehicle is prepared for erection on former Vanguard launch pad at Cape Canaveral, Fla. The stage is serviced and erected by a boom instead of a gantry. Photo at bottom right on opposite page shows prelaunch of the first USAF Blue Scout Jr. research and development vehicle. This vehicle tested launch techniques (AW Sept. 26, p. 29).

USAF's Blue Scout Jr. Tested Launching



Blue Scout Jr. second stage is a Hercules ABL-X-254-A1 solid rocket motor. Hydrogen peroxide rockets control pitch, roll and yaw. Blue Scout Jr. was first vehicle to be fired in the Hyper Environmental Test System (HETS) 609A program. A HETS 609A vehicle is intended to carry a 500-lb. Dyna-Soar model to 300,000-ft. altitude and speed of 20,000 fps. next spring.



Blue Scout Jr. research rocket is not raised to launching position until T–40 min. Inset shows makeup of four-stage solid-propellant vehicle.

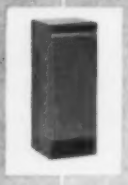
Techniques

Small spin rockets on the first stage (above) are used on launch to stabilize rocket. Unguided Blue Scout Jr. is launched at 70-deg. angle unlike other models to be launched vertically.

BENDIX G-20

WITH ORGANIZATION CHART DESIGN

MEANS PRACTICAL EXPANDABILITY IN



BALANCE WITH APPLICATION GROWTH

Just as the organization chart of any enterprise provides the framework for dynamic growth and adaptation, so "organization chart" design provides the framework for unparalleled expandability in the Bendix G-20 data processing system. This means that your G-20 can economically match, step by step, your expanding scientific or business computational workloads ... without sacrificing system balance. • Key to the organization chart efficiency of the Bendix G-20 is the ability of the Central Processor to "delegate" routine data handling tasks to control buffers, acting as "line supervisors." Thus freed, the Central Processor can make most efficient use of its high computation speed, its ability to schedule program priorities and direct accessory equipment assignments. • The ability to employ many control buffers gives new meaning to expandability in the Bendix G-20. Up to 70 input/output units can be directed by each of these "line supervisors." The Bendix G-20 has a complete line of accessory equipment including keyboard, paper tape, punched cards, high speed line printers, and 2 million word magnetic tape units. • Memory represents another dimension of G-20 expandability, ranging from 4,096 to 32,768 words. • Investigate the organization chart design of the Bendix G-20. See how it provides balanced, *practical* expandability ... at a cost that assures unequalled data processing performance per dollar invested. • ***For detailed literature write:***

Bendix Computer Division
DEPT. AF-27 LOS ANGELES 45, CALIF.

THE Bendix CORPORATION

Mercury Landing System Tests Completed

Washington—Radioplane has completed qualification of the Project Mercury capsule landing and recovery system as National Aeronautics and Space Administration's manned satellite program moves into a critical flight test stage.

Tight Mercury development schedule requires subsystems to be developed and proved concurrently with the development and early flight testing of the capsule (AW Aug. 8, p. 26) so a fully-qualified, integrated capsule system will be ready for the first manned ballistic flight within the next four months. Ballistic flight tests of the capsule system with Redstone and Atlas boosters are scheduled before the first manned flight.

Test Program

Mercury landing system was developed and tested during an 18 month program conducted by Radioplane Division of the Northrop Corp. under subcontract to McDonnell Aircraft Corp. System has been accepted by McDonnell and NASA.

Two-stage Mercury landing package uses improvements of existing equipment, and the 18-month Radioplane effort has been aimed at a parachute landing system with maximum reliability. Development and test were accomplished with only one failure in 56 aircraft drops using full-scale engineering models of the capsule (AW Feb. 15, p. 52).

System reliability, which Radioplane rates at higher than 99%, also has been demonstrated by its use in 22 flights by NASA in off-the-pad abort, Little Joe, Big Joe and Atlas tests of engineering and production capsules.

Single Test Failure

Single failure in the Radioplane program occurred on the 41st drop in a test of the effectiveness of the reserve parachute. The main recovery parachute was intentionally disconnected, and when the reserve chute deployed, the harness riser was slashed by a sharp surface on the antenna section. The capsule model fell 6,500 ft., broke apart on impact.

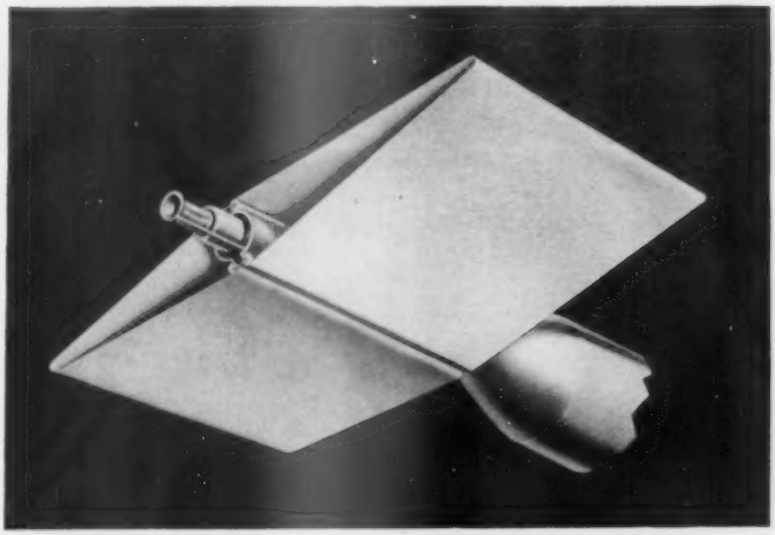
As a result of this test, fittings on production capsules were rounded or blunted to eliminate potential hazards of sharp edges.

Mercury landing package consists of a drogue parachute, main and reserve recovery chutes, aneroid and inertial sensors, explosive actuators and recovery aids. Normal landing sequence begins at 42,000-ft. following capsule re-entry from orbit. The aneroid instrument senses this altitude and closes an electrical circuit to ignite a mortar shell, ejecting the 6 ft. ribbon drogue parachute. The drogue chute, first stage in the system, rapidly inflates to stabilize the capsule and to slow it from Mach 1 velocity to a true airspeed of 160 kt.

The drogue chute, which is included basically as a means of stabilizing the descending capsule, initially was programed to deploy at 60-70,000 ft. As actual flight trajectories were refined, 42,000 ft. was found to be the best altitude at which to inflate it.

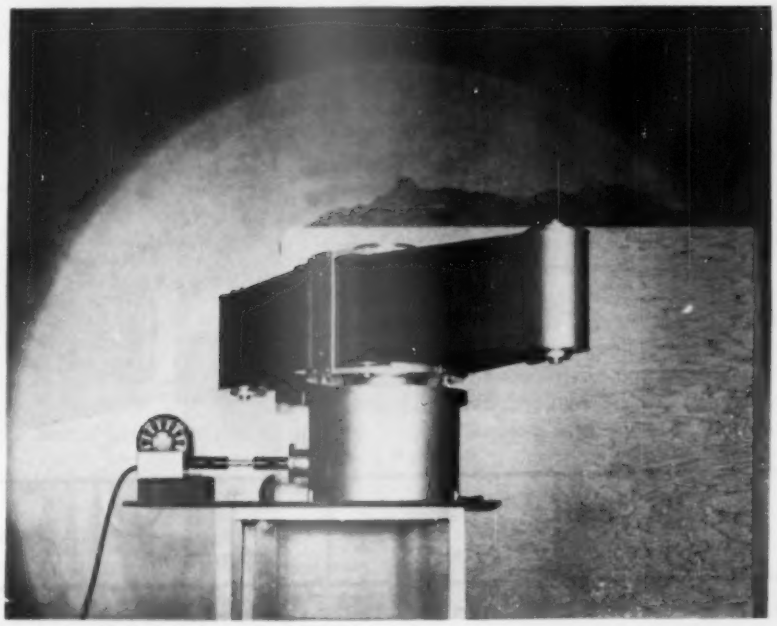
At 10,000 ft., the drogue chute pulls the second-stage main recovery chute from its pack, then drops off with the antenna cannister. Opening shock of the 63 ft. Ringsail main parachute is attenuated by delayed deployment. The Ringsail chute remains partially reefed for 4 sec. before it inflates fully.

The main chute slows the capsule to



Rocketdyne Develops Space Heat Radiator

Moving belt heat radiator for satellites, shown in artist's conception above, is under development by Rocketdyne Division of North American Aviation, Inc. Designers say it will operate even if punctured by meteoroids; hardware test below involves puncturing by .22 caliber bullets. Belts extend from waste heat rejection core and move continuously to dissipate heat. Speed can be preset to maintain constant temperature.

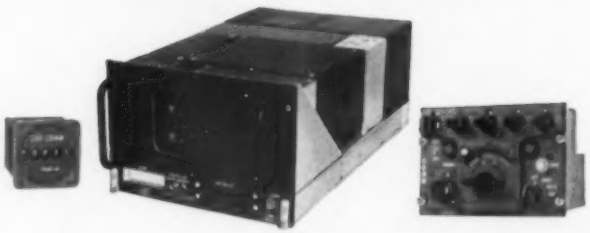


Magnavox continues to maintain a position of leadership in the airborne communications field.

Magnavox engineering, in conjunction with the Air Force, has developed an advanced airborne communication system that is designed to meet the requirements of the future. Utilizing wide band techniques, such functions as television relay for bomb damage assessment, data link for control and identification, and many other forms of air-to-air and air-to-ground communications can all be realized over the same equipment as used for voice.

Magnavox

AN/ARC-50 SYSTEM



COMMUNICATIONS | RADAR | DATA HANDLING | ASW | MISSILES

THE MAGNAVOX CO. • DEPT. 301 • *Government and Industrial Division* • FORT WAYNE, IND.

a landing speed of about 30 fps. and is disconnected on water contact by means of an explosive charge ignited by the inertia switch.

Ringsail system was invented for the Navy by Radioplane's Edward G. Ewing. Mercury Ringsail is an enlargement of the original design, which was evolved from the aircraft braking Ringslot parachute system. Drag coefficient of the Ringsail has been raised to a value of 0.72, compared with 0.55 for the Ringslot.

Recovery aid sequence begins with deployment of the drogue chute, when a cloud of radar chaff is ejected at 42,000 ft. When main chute deploys at 10,000 ft., excess control jet hydrogen peroxide fuel is dumped overboard through pitch and yaw thrust chambers, the antenna section is jettisoned and communications links shift to antennas inside the afterbody. A sound fixing and ranging (SOFAR) bomb is dropped, and Sarah and Sea-Save rescue beacons are activated.

When the main parachute disconnects, a balloon trailing an HF antenna is inflated with helium and released.

Dye marker will be either finely divided aluminum or fluoresceine. Both the dye marker and shark repellent are carried under the capsule heat shield, and they dissolve on water contact.

Since possibilities are relatively remote that the capsule will come down on land, water landing has received Radioplane's qualifications emphasis. Salton Sea facility was used as test site by the Paradynamics Group, which required only two engineering models to complete its program of dropping capsules with sequencing and equipment failures built in to check reaction to emergencies.

Laboratory Checks

Salton Sea drops were preceeded by a laboratory checkout program in which each element received an average of 24 tests to assure ruggedness. Components were subjected to conditions of high and low temperatures, high altitude, vibration, noise, shock and humidity. Tests were conducted in salt spray, sand and dust.

Explosive charges were dropped from a height of 40 ft. and stored at high temperatures. Cartridges underwent 10 min. no-fire test with 18-volt, 0.5 amp. charge to assure that they will not be inadvertently ignited by intense signal fields at Cape Canaveral.

Sequencing equipment was subjected to 400 runs to test its operation in both normal and aborted missions.

An off-the-shelf ribbon drogue parachute originally was planned as first stage for the landing system. Early free-flight drops from a modified Lockheed F-104 aircraft over the NASA High Speed Flight Station at Edwards, Calif., showed a destructive pulse vibration when the drogue chute was deployed at transonic and supersonic speeds.

The trouble was traced to a "yo-yo" effect, caused by stretch and rebound action of the highly-elastic nylon riser, which resulted in inflation and deflation at a rate of 30-50 pulses each second and effectively shook the drogue chute apart.

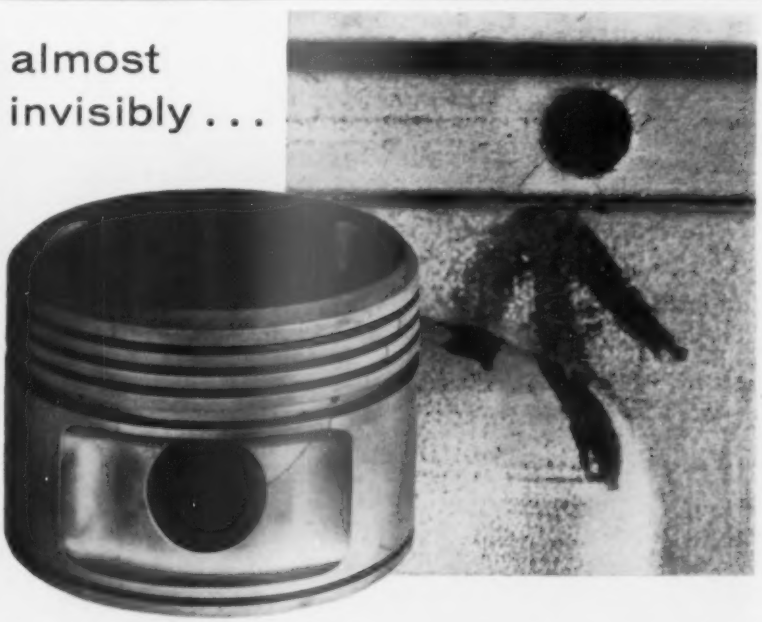
The 36 ft. nylon riser was replaced with equal length of Dacron, having less than half the elasticity. Subsequent free flight tests, using a 1,600 lb. bomb dummy, were made successfully with the new riser at speeds up to Mach 1.6 and altitudes as high as 72,000 ft.

NASA Organizes Division For Materials Research

Washington—National Aeronautics and Space Administration has established a new headquarters division to centralize expanding materials research.

George C. Deutsch, formerly head of the refractory materials branch at NASA's Lewis Research Center, is chief of the new division. Functions of the new division—establishing and monitoring NASA and contracted materials research and development—formerly were performed by Powerplants and Structures Divisions in the Office of Advanced Research Programs.

almost invisibly . . .



trouble grows in tired metal

The enlarged piston section at the right has a fatigue crack. It is almost invisible to the naked eye, even though an etch treatment has been used to make cracks easy to see. If the inspector doesn't spot this crack at overhaul, it will grow and become as dangerous as the one in the piston at the left.

Airwork uses two separate methods of piston crack determination; (1) etching treatment, followed with a binocular microscope of the critical areas, (2) Zyglo inspection. We have some of the most extensive black light inspection facilities in the East.

You can't afford less than the best available inspection of your engine at teardown. That's one more reason why an Airwork overhaul is good insurance of reliable performance.

Airwork CORPORATION
Millville, New Jersey

ATLANTA • CLEVELAND
MIAMI • NEWARK • NEW YORK
BOSTON • WASHINGTON

Nuclear claws for a new breed

of Falcons

The Hughes Falcon GAR-11 is the first air-to-air guided missile to pack a nuclear punch.

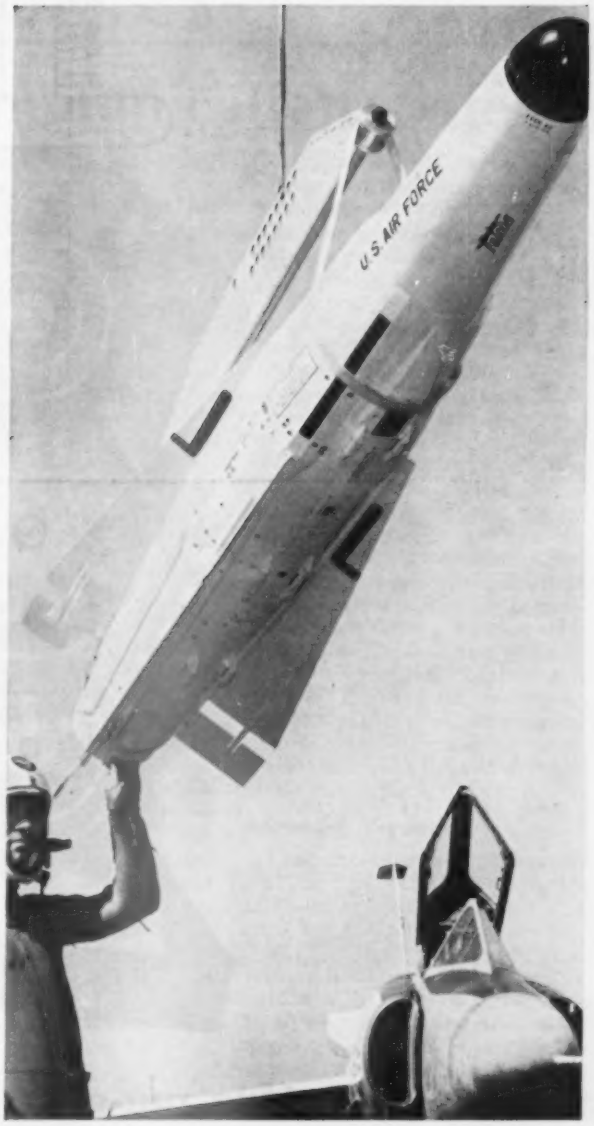
Developed by Hughes, the "Nuclear Falcon" adds a major new weapon capability to our defense arsenal. A weapon that can down *any* bomber in the skies.

Because of its heavy blast intensity and high degree of accuracy, the "Nuclear Falcon" is particularly effective in high-speed closures against bombers carrying the deadliest of weapons.

The Falcon family has proven itself in operational service—every modern U.S. all-weather interceptor carries Falcon missiles. In simulated tactical firings Falcons have achieved unexcelled records for accuracy and reliability.

Like other Hughes weapons, systems and components, the Falcon is a product of Hughes' unique capabilities in virtually every area of advanced electronics. These include projects in space systems, airborne control systems, microwave communications, data processing and display systems, ASW systems, radar and IR detection systems—and many others.

These advancements in the state of the electronic art are based on foresight, imagination, and proven management capability. Their reliability and operational capabilities have earned them the confidence of users throughout the free world.

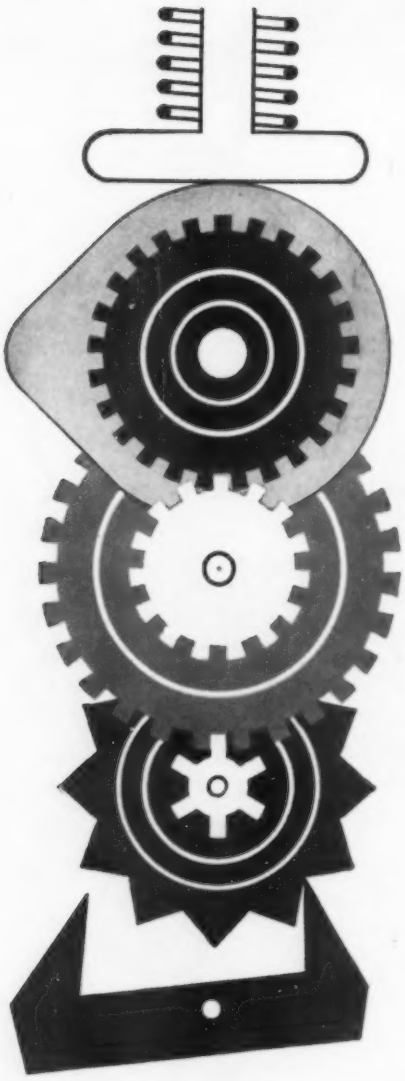


Larger than earlier Falcons, *yet small considering its nuclear capability, the GAR-11 is 7 feet long, 11 inches in diameter and weighs slightly more than 200 pounds.*

Creating a new world with ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo, Fullerton, Newport Beach, Malibu, Oceanside, Santa Barbara and Los Angeles, California; Tucson, Arizona



Bulova run-away escapements

Bulova's mastery of the measurement of time holds practical solutions to some of the growing challenges in defense and industry. One case in point is the Bulova run-away escapement: a simple, rugged and relatively inexpensive device for metering short periods of time. Currently used in accelerometers and velocity indicators, these mechanisms have wide areas of application yet to be explored.

The artist's conception above depicts a run-away escapement designed for governing the speed of a cam system driven by a mainspring. The torque transmitted through the gear train rotates the scape wheel which, in turn, oscillates the pallet. The starting and stopping of the pallet as it oscillates acts as an inertia brake or governor on the whole system.

The idealized equation defining the motion of the pallet is simply

$$T_p = I_p \frac{d^2\theta}{dt^2}$$

The initial conditions at $t=0$ are $\theta=0$ and $d\theta/dt=0$. Integrating *Eq (1)* twice and applying the initial conditions results in

$$t_1 = \sqrt{\frac{2I_{p1}\theta_1}{T_{p1}}}$$

where θ_1 and t_1 denote the half-cycle amplitude and half-cycle period respectively, and the total pallet amplitude is $\theta_1 + \theta_2 = 2\pi/n$.

In this example, the escapement controls the action of a cam-follower mechanism. The same principle can be adapted to many other applications such as: a timer for closing an electric circuit: a velocity indicating device used in computers for integrating acceleration-time functions.

Bulova skills come from close association with the involved problems in developing, designing and producing timing mechanisms which fully meet the stringent specifications of the military and industry.

BULOVA

Bulova Research & Development Laboratories, Inc.
62-10 Woodside Avenue, Woodside 77, New York

Army Describes Communications Satellite

By Philip J. Klass

Washington—Details of a "hypothetical" communication satellite system which bears close resemblance to the Project Advent communication satellite system now under development were reported here by Army Signal Corps scientists who work on Advent during the recent Space Electronics and Telemetry Symposium.

Like Project Advent, the hypothetical system employs active-repeater satellites in synchronous orbit at 22,300-mi. altitude and is designed to provide both point-to-point and area coverage, serving fixed and mobile terminals, including aircraft.

Like Project Advent, the system described here is intended to grow into its full capability in phases or transitional stages. Initial satellite in system described here would weigh 1,000 lb., the same as the Defense Department estimate for the first Advent satellite.

Interestingly, the system described here initially would use ground stations which are nearly identical to those which the Army already has constructed for use with its Project Courier delayed repeater communication satellite. Presumably, early versions of Advent will be designed to use existing facilities such as these.

James E. Bartow of the Army Signal Research and Development Laboratory, who delivered the report here, declined to comment on possible similarities between the system he described and Project Advent; he said that details on the latter are classified. However, he acknowledged that he is working on the Advent program. Report was co-authored by Donald L. Jacoby and George N. Krassner of the same laboratory.

Limited Capability

The hypothetical system which Bartow described would be established in a two or three-step program, starting with a small, low-power satellite of limited capability which would be replaced with higher-power satellites providing more voice communications channel capacity plus television.

Bartow raised the possibility that some channels in a military communication satellite system or the satellite design itself might be made available to commercial users. "Because of the high cost of a communication satellite system, it is imperative that it satisfy the greatest number of potential users . . . both military and commercial," Bartow said.

"Economic considerations dictate that ground stations will be located near major communications centers so that they will have an operational capability at the conclusion of research, development and engineering evaluation," he added.

The ground station which Bartow suggests for the first phase would employ facilities which are almost identical to those in the two ground stations which Army has established at Fort Monmouth, N. J. and in Puerto Rico for use with its Project Courier delayed-repeater satellite (AW Aug. 29, p. 72). Features are:

- **Antenna diameter:** 28 ft.
- **Power output:** 1 kw.
- **Bandwidth:** 1 mc. per channel.
- **Receiver noise temperature:** 100K.
- **Carrier-to-noise ratio:** 22 db.

Satellite Characteristics

Communication satellite designed for initial phase of system implementation would weigh about 1,000 lb., of which 250 lb. would represent communications equipment, telemetry and tracking beacons. Shell and structure are estimated at 200 lb., power supply at 250 lb. and attitude/station-keeping control system at 200 lb. Antenna system is estimated at 30 lb., with remaining 70 lb. unassigned as a safety factor.

Here are the operating characteristics of the initial-phase communication satellite:

- **Number of channels:** 10.
- **Bandwidth:** 1 mc. per channel.
- **Frequency range:** 1,700 to 2,400 mc. (The same as for Project Courier.)
- **Power output:** 1 watt per channel.
- **Antenna gain:** 18 db.
- **Antenna diameter:** 20 in.
- **Primary power:** 300 watts.

To provide maximum over-all reliability, the initial phase satellite will use multiple narrow-band channel design so that it is radiating at 10 different radio frequencies. Failure of any one channel will not cause loss of remainder of satellite capacity. Transmitter output tubes will be triodes which will be operated with sharply derated output levels to provide long life.

At the selected operating frequency, the 20-in. diameter antenna would produce a beam approximately 20 deg. in width, capable of illuminating about one-third of the earth, exclusive of the polar areas. Antenna will be fixed to satellite shelf and will depend upon satellite attitude control to keep it aimed at the earth, to within an estimated two degrees. Station-keeping controls would be designed to keep satellite in its desired latitude/longitude within two degrees.

Advanced Version

The more advanced communication satellite is expected to weigh about 3,000 lb. of which 1,100 lb. is allocated for the communications equipment. The larger payload will provide increased bandwidth: 600 mc. total compared with 10 mc. for the earlier version. To obtain necessary spectrum, satellite operating frequency is expected to move up to the 4,400 to 5,000 mc. region.

By using traveling wave tubes in the satellite to give an output power of five watts per channel, six wideband (100 mc.) basic channels will be realized. Each will be capable of supplying 1,000 commercial or unencrypted voice channels plus one television channel. Where encrypting is required for military use, each basic channel will provide 100 voice channels or one for TV.

Satellite will use an inflatable or unfurlable parabolic antenna with a diameter of 5 ft., giving a beamwidth of about 2.8 deg. This relatively narrow beam will provide increased directionality, and thus privacy, for military communications. However, it will require greater precision of control of satellite attitude and position, each to within one-half degree, Bartow said.

The advanced communication satellite will require continuous power supply of about 1,000 watts. This, like power needs of the earlier version,

Advent Subcontractors

Bendix Corp.'s System Division and General Electric's Missile and Space Vehicle Dept., are the two major subcontractors on the Project Advent Communications satellite, intended for synchronous equatorial orbit. Bendix will develop the communications payload, including receivers, transmitters, command and control equipment while GE will develop satellite vehicle itself and its electric power supply. Entire program is under the direction of Army Signal Corps. Bendix's contract is with the Army, while GE's is with the Air Force's Ballistic Missile Division, which is responsible for the launch vehicle under over-all Army direction.

would be supplied by combination of solar cells and batteries.

A third generation communication satellite, with still more precise attitude control, may be equipped with a 20-ft. diameter inflatable parabolic antenna. This larger antenna, coupled with a shift to a still higher operating frequency in the 5,000 to 10,000 mc. band, would provide even greater directionality and privacy.

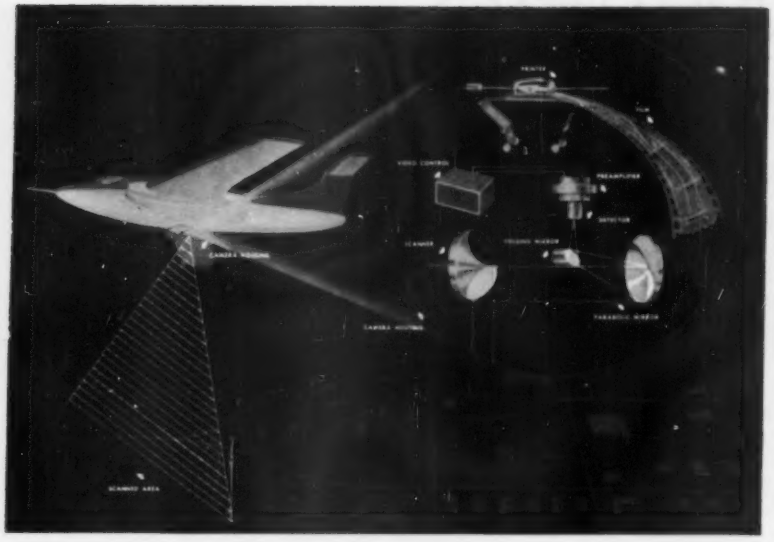
The third generation satellite might be powered by a solar-regenerative fuel cell. Working medium would absorb solar energy and decompose into basic elements which would pass through the fuel cell and produce electricity.

To achieve increased bandwidth channels, improvements also would be required in the fixed ground stations. Transmitter power would be increased from 1 kw. to 10 kw., and 60-ft. diameter antennas, with 56 db. gain, would replace the 28-ft. models used with earlier version. Mobile stations would employ smaller transmitter and antenna.

Reliability

Initial versions of the communication satellite would be expected to have a useful life of one-half year to a full year. With use of redundant circuitry in advanced models, it should be possible to extend useful life to two years or more, Bartow indicated.

The communication satellite systems described "appear to be attainable in the not too distant future," Bartow said. "Early evaluation of a limited capacity system will be followed by higher capacity, more advanced systems suitable for operational use, using boosters such as the Saturn. Timely consideration of the actual military and commercial requirements will result in an effective development program and an optimum system design," Bartow concluded.



Infrared System that gives Outstanding Thermal Mapping Results

a major advance in infrared by HRB-SINGER

HRB is now permitted to discuss, outside military circles, some of the company's achievements in the field of infrared reconnaissance.

Pictured above is a schematic of the RECONOFAX® infrared system at work. Outstanding results from this system include the recently released "Manhattan Island" in which detail is accurate enough to reveal undeveloped areas in Central Park, and residential, commercial and industrial areas throughout New York City.

Data may also be collected and relayed to earth for instant viewing—a technique which will prove useful in the area of combat surveillance. Hundreds of targets can now be closely scrutinized back at field headquarters without fear of losing the observation aircraft's recorded information.

Write HRB-SINGER, INC., Dept. I, for a complete series of data sheets on HRB's RECONOFAX® systems.

ELECTRONIC RESEARCH AND DEVELOPMENT in the areas of: Communications • Countermeasures • Reconnaissance • Human Factors • Astrophysics • Antenna Systems • Special Studies Intelligence • Weapons Systems Studies and Analysis • Operations Research

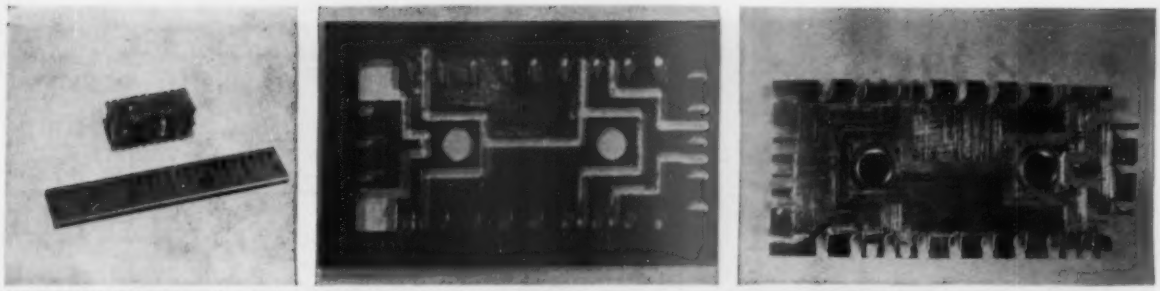
HRB

HRB-SINGER, INC.
A SUBSIDIARY OF THE SINGER MANUFACTURING COMPANY
Science Park, State College, Pa.

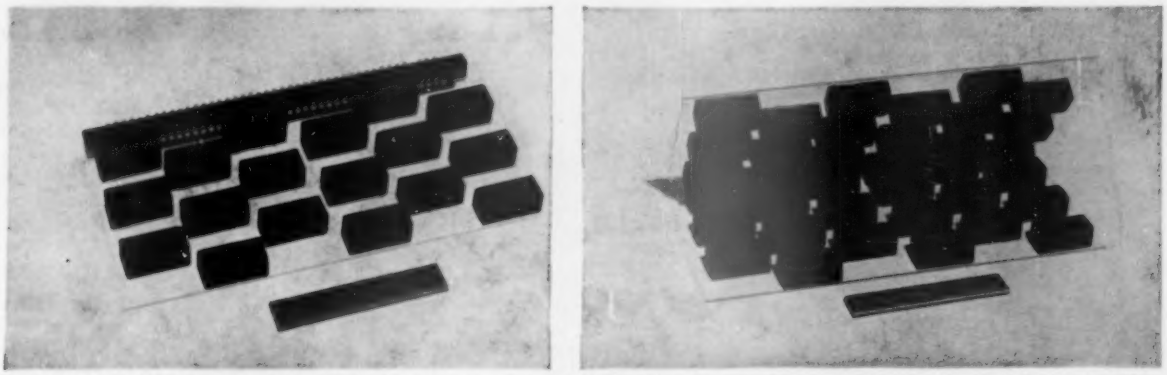
SINGER

Security Adapter

Security telephone adapter, placed over telephone handset, automatically scrambles outgoing message and unscrambles incoming message from other security telephone adapter user. No wires or connections to telephone handset are required. Device employs 10-transistor circuit, weighs 27 oz., contains built-in battery power. Manufacturer: Delcon Corp., 943 Industrial Ave., Palo Alto.



WELDED PACKAGES under study at Autonetics would use standard, encased components mounted in a non-stressed fashion around periphery of a submodule and be accessible for replacement. Projected submodules would be of same size and layout as unit at left, but would employ stamped wiring with leads welded to tabs bent normal to board surface at each component position. Stamped wiring is made by blanking a standard pattern from a light weight, metallic ribbon with a roll die. During blanking, tabs (visible in center cut) at nine component positions along length, five on end, are bent up simultaneously. Final form of stamped wiring board has rectangular-shaped glass coating covering the board except on periphery where connections are made to components, and has center supporting studs riveted in and edge of ribbon board removed.



WELDED AUTONETICS submodules will be dip-soldered on two-sided etched board in checkerboard fashion to form a half-module. Connections among individual submodules are made along etched board. Two half-modules can be fitted together with submodules (right) on one half-module board fitting into vacant checkerboard pattern on the other to form a tight ½-in. wide sandwich.

New Component Packaging Idea Studied

By Barry Miller

Downey, Calif.—Unusual concept of packaging conventional avionic components into digital computers which may combine the features of high reliability, compactness and low-cost with simple, easy maintenance is being explored here at the Autonetics Division of North American Aviation.

Basically, the concept, dubbed Densely Packaged Encased Standard Elements (DENSE) is a variation of the weld-pack or welded-module technique (AW Aug. 24, 1959, p. 104) which, its advocates contend, enjoys the advantage, attributed to the use of available assured quality level components and familiar assembly techniques, of being practicable now. Indeed, weld-pack techniques already are employed by more than a dozen companies in a variety of programs including the construction of guidance computers for the inertial systems of the Titan ICBM and the fleet ballistic missile Polaris.

The weld-pack technique is a method of tightly packaging components into modules much like stacked logs—hence another descriptive name—log piling—sometimes used in designating the technique. Interconnections of components are made not by soldering but rather by controlled electrical resistance spot welding similar to that used in making miniature electron tubes. Spot welding offers the advantage of a quick heat cycle which permits connection of components in close proximity without fear of damage from excessive heat.

Unlike the earlier welded pack approaches, the Autonetics concept does not use or need the potting compounds which other approaches find necessary for structural rigidity as well as component protection. Its components are accessibly located on the perimeter effectively of its basic modular construction and, consequently, it allows easy maintenance and individual component replacement rather than the more expensive discarding of an entire building block.

William A. Farrand, Autonetics engineer responsible for the DENSE concept, emphasizes that it is still in the concept rather than the hardware stage. But, he says, the use of proven techniques and conventional components whose reliability is not in question should be able to reduce the concept to production practice in 12 months. Parts densities attainable using the DENSE concept and conventional components, Farrand adds, rival those claimed for the microminiaturization approaches which must yet master new technologies and/or use of relatively unknown micro components.

At least for the present, Autonetics is staying with standard printed circuit board techniques for the guidance computers of its major effort, developing guidance systems for the Minuteman intercontinental ballistic missile. Presumably, both Farrand's work and a separate microminiaturization program could be used in later equipment should they be desired.

From an analysis of Autonetics' computers, Farrand concludes that basic

WEAPON SYSTEMS BY REPUBLIC'S MISSILE SYSTEMS DIVISION

Bridging the scientific and technical gap between military necessity and tested, proved, reliable weapon systems is the task of Republic's Missile Systems Division. Our scientists and engineers plan, direct, and supervise projects from conception to operational hardware . . . through systems synthesis and analysis, research and development, prototype fabrication, test, and production. ➤➤➤ Republic designs and builds completely integrated systems for performing vital defense functions.

Present programs include work in:

- **Air/Space Vehicles**
- **Guidance and Control Systems**
- **Infrared, Radar and Photographic Sensors**
- **Data Processing and Display Equipment**
- **Ground Support Equipment**
- **Secure Communications Links**
- **Nuclear Weapons Phenomenology**

REPUBLIC AVIATION

MISSILE SYSTEMS DIVISION

MINEOLA, LONG ISLAND, N. Y.

standard submodules can be built without paying too great a penalty for standardization. Each submodule in the DENSE concept represents some basic function, or a portion of one, such as a flip flop, read or write amplifier, logic module, cable driver, etc. The submodule would have optimized dimensions of 1.1 in. in length, ¼ in. in width, ⅛ in. in thickness and could accommodate a maximum of 28 standard encased components in given positions (this would provide component densities in excess of 200,000 components/cubic inches when all 28 positions are used). Components are dropped into slots between two parallel stamped wire boards much like railroad ties and are then welded to tabs at each slot.

The step-by-step DENSE construction approach is as follows: standard wiring patterns for interconnections of components in basic submodule circuits are repetitively blanked out of a long, narrow (in excess of ¼ in. width) metallic ribbon by a roll die. As the pattern is being stamped, tabs on the ribbon to which components will later be welded are turned up normal to the surface of the ribbon. The resulting pattern on the ribbon is a kind of doiley pattern with the retained metallic portions being the eventual conducting paths between elements. This stamped wiring doiley pattern has an outside connecting ridge to prevent it from crumbling during handling.

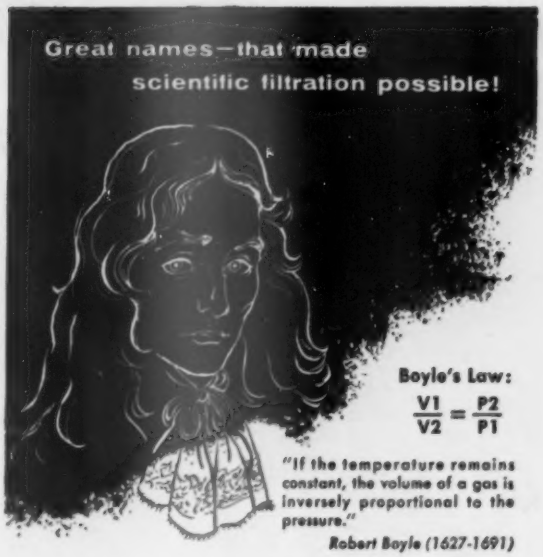
Copper Ribbon

The ribbon is made of beryllium copper, a compromise of a good weld material and one which can still take solder. It is light weight and in production will be cheap.

After a glass covering is placed over the center portion of the ribbon and epoxied to it to hold the pattern together, the connecting ridge is then sheared off. Two pieces of this stamped wiring board or demimodules as they are called are joined together by two center studs which are riveted into both pieces.

Thus, the basic submodule structure—namely, two stamped wiring boards held facing one another and separated by two studs stands less than ½ in. in height. Components can then be placed around the periphery of the module with their axial leads resting against slots in the wiring boards. Transistors are not glued back-to-back as they are in other weld-pack approaches but are supported by the strength of their own leads. A maximum of nine components can be placed along either length of the module; five on the ends. Component leads can then be welded to their respective tabs. All components are situated on a 1/10 in. grid system.

Because the submodules are structurally sound, Farrand says, encapsula-


Great names—that made
scientific filtration possible!
Boyle's Law:
V1/V2 = P2/P1
"If the temperature remains constant, the volume of a gas is inversely proportional to the pressure."
Robert Boyle (1627-1691)

Liquid and gas filtration has been the specialty of Air-Maze for the last 35 years. Yet Boyle's 270 year old discoveries relating to the compression and expansion of air and other gases must be recognized and taken into consideration by our engineers in designing new equipment to keep modern machinery operating efficiently.

From diesel engines to jet aircraft . . . from lubricating oil filters to industrial pumps, filtration products by Air-Maze are keeping equipment running better and longer by keeping it clean and free of destructive contaminants.

The representative products shown below were designed and developed by Air-Maze engineers to solve highly specialized filtration problems. If your product involves any gas or liquid that moves, Air-Maze engineers can help you.

Liquid or Air Filters—from missiles to private aircraft there is an Air-Maze filter to meet your requirements.
In-line Filters—small, lightweight. These filters are used in missile hydrazine fuel systems.
Permanent Cleanable Panel Filters—for carburetor air intakes.
OTHER AIR-MAZE PRODUCTS:
Air Filters • Liquid Filters • Intake Silencers • Exhaust Spark Arresters • Breather Filters • Oil Mist Eliminators
AIR-MAZE
CLEVELAND 28, OHIO
A SUBSIDIARY OF ROCKWELL-STANDARD
ROCKWELL R STANDARD

tion of the entire assembly is not necessary and components can be cooled by air radiation. Faulty components in a functioning assembly can be located, removed because they are on the outside of the submodule and replaced. The substitute components can be soldered rather than welded into the assembly so that location of a replaced component can be noted from the soldering joints.

Component Failure

When a component fails in other weld-pack approaches where components provide structural strength of the pack, the philosophy calls for discarding the entire pack. At times the potting compound will crack and split components. Use of this throw-away philosophy is a matter of logistics for a particular application. Costs of throw-away units at times become staggering. For example, an engineer from Sippican Corp., a pioneer in this field, has stated that costs of throw aways he has worked with would run up to $3,500 were they in production.

Ferrand indicates however that it is not certain that welded joints without encapsulation will prove sufficiently reliable for Autonetics use. Should they fail to be, a more complex weld structure which uses a redundant non-stressed weld may be employed.

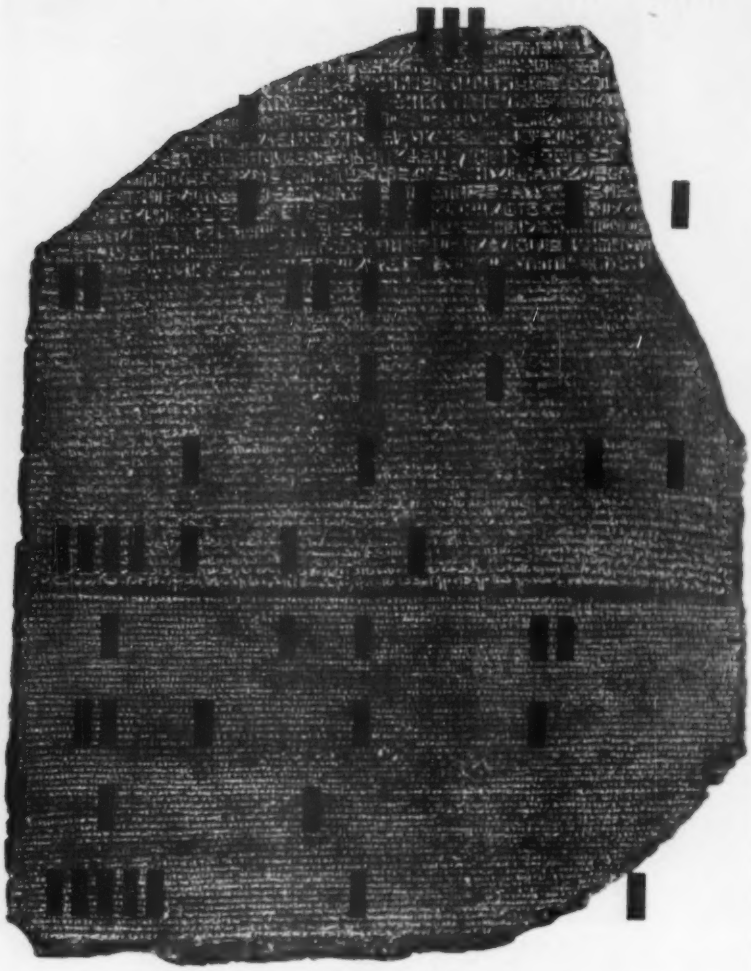
To interconnect functions, submodules are soldered in a checker-board fashion onto a two-sided etched board in such a manner that components in their submodules are normal to the etched boards. This forms a half module and interconnections are made among submodules on the etched board and the submodules are coated with polyurethane for insulation. Two half modules which are hermaphroditic to each other can then be sandwiched together to form a module approximately ½ in. thick. The two half modules can be bolted together through the stud in the submodules and spacers placed atop them. The result is an extremely light, but mechanically strong unit.

Standard Connectors

The modules use standard printed circuit board connectors. Each module occupies ½ of two connectors at no sacrifice in space, Farrand says, and gives a module with insulated outside surfaces, thus protecting the connector faces from mishandling.

As for the status of this work, Farrand says a flip flop has been made and tests satisfactorily. In addition, a complete computer using this approach and measuring 4 x 8 in. on a ½ in. center has been laid out.

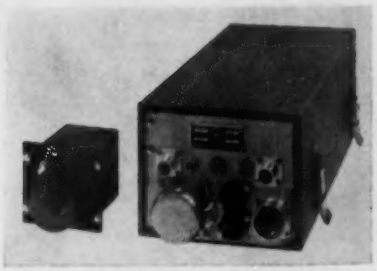
Hand assembly of and testing individual submodules is a relatively simple procedure, Farrand points out. The assembler can be supplied with a sample



The Rosetta Stone unraveled secrets that had been buried for centuries. It bridged the gap between known civilization and unknown, ancient Egypt. The discovery of the Stone was an accident, one of those curious events that sometimes happen. ¶ Modern science faces a language problem much more complex than deciphering of hieroglyphics. And once again a Rosetta Stone is needed. But science cannot wait for an accidental discovery. ¶ Each branch of science has its own language which it uses to state problems. But electronic computers can solve problems only if they are posed in the language of the specific computer. Translating science languages into computer languages is enormously costly in time and money. UNCOL (Universal Computer Oriented Language) is a possible solution. The development of UNCOL will bridge the gap between a multitude of Problem Oriented Languages and an increasing number of Computer Languages. UNCOL is one task which occupies scientists at System Development Corporation. ¶ **SYSTEM DEVELOPMENT CORPORATION.** A non-profit scientific organization developing large-scale computer-based command and control systems. Staff openings at Lodi, New Jersey and Santa Monica, California.

SDC

EI-169



Transmitter-Receiver

Medium/high frequency radio transmitter/receiver, for long-range air-ground communications, covers frequency band of 2 to 13 mc. Equipment weighs 16 lb. including remote channel selector. Transmitter output is 53 watts. Operation is from 14 or 28 vdc. Model number is N414. Manufacturer: Northern Radio Co., Seattle, Wash.

submodule, placed next to unfilled submodule. Then a maximum of nine components can be inserted in respective slots as indicated by the master. Welds can be visually inspected and faulty welds spotted more quickly than faulty solder joints. Units can then be thrown into a hopper and tested.

To assist one another in developing and to exchange information on welded packaging techniques, a number of companies active in welded packaging have organized an informal committee which has held three meetings during the past year—the first at American Bosch Arma in Garden City, N. Y., the second at Sippicon Corp in Marion, Mass. and most recently, the third meeting in late August at Autonetics here in Downey.

Participating in this committee are the following companies: AC Spark Plug, Aeronutronics, Airborne Instruments Laboratory, Alloyd Research, American Bosch, Amphenol-Borg, Autonetics, Boeing, Burroughs, Convair, Electronic Engineering Co., Emerson Electric Mfg., Engineered Magnetics, Francis Associates, General Electric, Hughes, International Business Machines, Kearfott, Litton, Lockheed, Martin, MIT Instrumentation Lab., Remington Rand Univac, Sippican, Space Technology Labs, Sperry Gyroscope, Walter V. Sterling, Sylvania Electric, and Westinghouse. In addition Diamond Ordnance Fuze Laboratories takes part, as do representatives of the Navy's Special Projects Office and the Air Force Ballistic Missile Division.

A major problem confronting growth of the welded packaging approach is the paucity of components which have leads with uniform welding tolerances. The industry committee at its last meeting set up a group which will attempt to meet with component manufacturers in an effort to get them to make compo-

Eliminates Instrument Interference!

• Just as we expected, many aircraft designers were interested in the recent announcement of our new non-magnetic aircraft cable. If you did not see it, "NO-MAG" has these characteristics:

NON-MAGNETIC PROPERTIES... "NO-MAG" cable is made from type 305 stainless steel. It remains non-magnetic after severe cold working —in contrast to standard stainless steel aircraft cable which shows a pronounced increase in magnetism after swaging, wire drawing or similar operations.

This non-magnetic property of "NO-MAG" cable eliminates instrument interference from cable magnetism.

CORROSION RESISTANCE... New "NO-MAG" cables have corrosion-resistant qualities similar to, but slightly better than, cables made of standard stainless steel.

GOOD THERMAL CHARACTERISTICS... The thermal expansion characteristics of new "NO-MAG" cable are much closer than those of standard stainless steel or carbon steel cables to the characteristics of aluminum alloys used in aircraft. This greatly simplifies maintaining cable tension under various changes in temperature.

HIGH FATIGUE RESISTANCE... Preformed construction and careful processing give new "NO-MAG" cable high fatigue resistance.

HIGH ABRASION RESISTANCE... New "NO-MAG" cable shows greater abrasion resistance than standard stainless steel aircraft cables.

TENSILE STRENGTH, while lower than that of stainless and carbon steel, is sufficient to enable replacing these, size for size, with "NO-MAG" on many applications where the characteristics of "NO-MAG" are required.

USE WITH SWAGED TERMINALS... Swaged terminals can be applied to standard AN dimensions.

COMPLETE RANGE OF SIZES, CONSTRUCTIONS... New "NO-MAG" is furnished in sizes from 1/16" to 1" in all of the standard aircraft cable constructions.

Get the complete story on this new technical development for the aircraft industry. Write today to Detroit office.

Automotive and Aircraft Division
AMERICAN CHAIN & CABLE

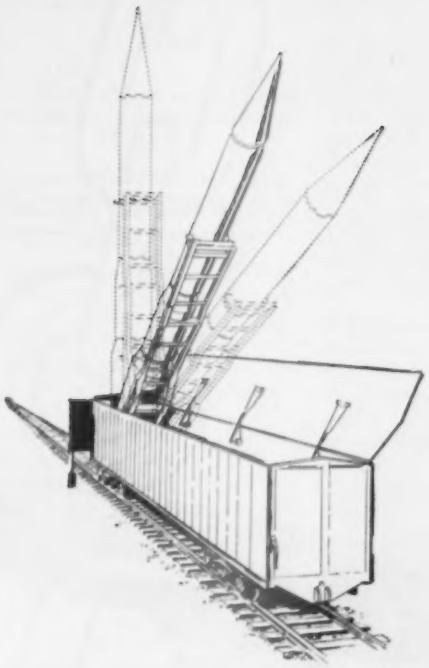
601 Stephenson Bldg., Detroit 2
6800 East Acco Street, Los Angeles 22 • Bridgeport 2, Conn.

special railroad car transporter and launcher for the Air Force Minuteman Missile . . . developed for Boeing jointly by ACF Industries, Inc., and American Machine and Foundry Co.

Contributing to the precision accuracy of America's missile and rocketry programs, American Car and Foundry's defense capabilities are playing their part in the development and production of ground support equipment for Minuteman, Rascal and Snark Missiles. Offering integrated service on the research, engineering and manufacturing levels, American Car and Foundry's facilities adapt to a wide range of requirements for the Armed Forces and prime or subcontractors. Here is knowledge and experience in depth which can ready your defense projects for field use.

AMERICAN CAR AND FOUNDRY

Division of ACF Industries, Incorporated
750 Third Avenue, New York 17, N.Y.



ACF's CHECK LIST FOR DEFENSE PROCUREMENT

☑ **engineering:** American Car and Foundry's engineering staff is trained to design from rough plans, develop the product to meet performance standards and create the processing equipment which will achieve the most efficient production.

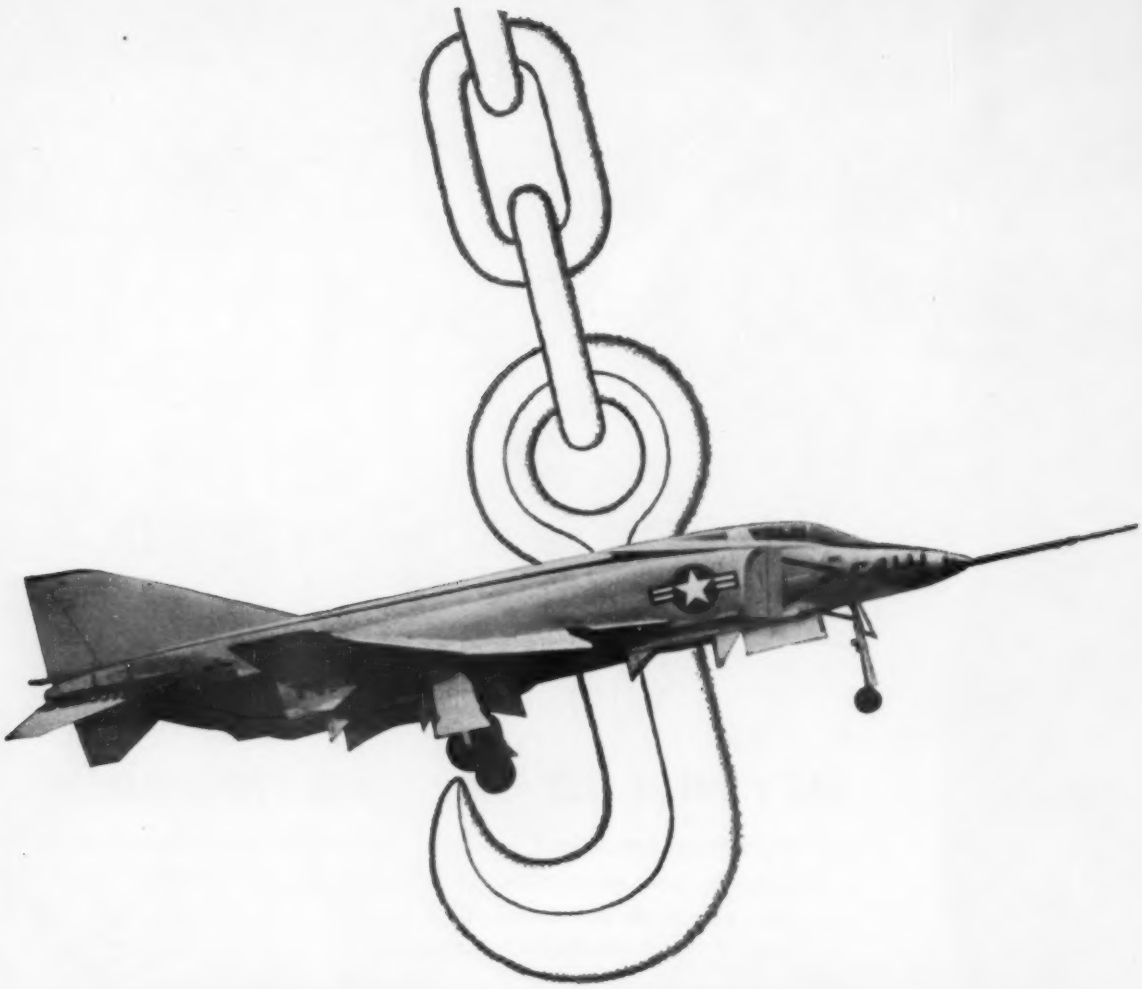
☑ **manufacturing:** Five huge plants offer advanced facilities for tooling, heat treating and fabricating both ferrous and nonferrous metals and modern alloys.

☑ **research & development:** From initial drawing to prototype, through pilot or full plant production—sound, modern, workable products.

☑ **quality control:** Every phase of the manufacturing process is inspected by up-to-the-minute equipment and techniques to insure highest standards of quality and performance.

☑ **experience:** Ammunition • Armored vehicles • Propulsion system components • Ground Support equipment • Transportation equipment • Communications hardware • Research and development

SALES OFFICES: NEW YORK • CHICAGO • CLEVELAND • ST. LOUIS • WASHINGTON, D.C. • PHILADELPHIA • SAN FRANCISCO



"SKY HOOK"

Landing speed of the McDonnell F4H reduced 8% by Solar built boundary layer control system

BOUNDARY LAYER CONTROL – achieved by bleeding air from the propulsion engine and directing it at sonic speeds over wing control surfaces – reduces by 10 knots the landing speed of McDonnell's F4H fighter.

Designed and manufactured by Solar, the F4H boundary layer control system makes possible safe, efficient carrier landings. Made from high strength, heat treated Inconel X, the lightweight system weighs only 98 lbs. It is tested to 172 psig and operates at 778F. Ducting wall thickness is .012 in. A special design feature allows passage of the ducting system through folding wing joints.

If your needs involve the design, testing and production of complete ducting systems for aircraft or missiles, call on Solar's proven capabilities in the field. Write today to Dept. H-168, Solar Aircraft Company, San Diego 12, California.

SOLAR
AIRCRAFT COMPANY
A subsidiary of International Harvester Company

nents which are suitable for welded assembly. While most lead materials can be welded, Farrand says, the time and money that would be lost if a systems manufacturer had to decide just how to weld each component might offset the value of welded packaging.

Ideally, uncoated pure nickel would be a fine lead material tolerable to welded parameters. Whichever one is selected, all leads should be made of the same material.

Instrument May Speed Missile Tracking Data

SORTI (for star-oriented real-time tracking instrument), now under study by the Air Force, represents an attempt to provide accurate, instantaneous missile tracking data for analysis and possible in-flight corrections.

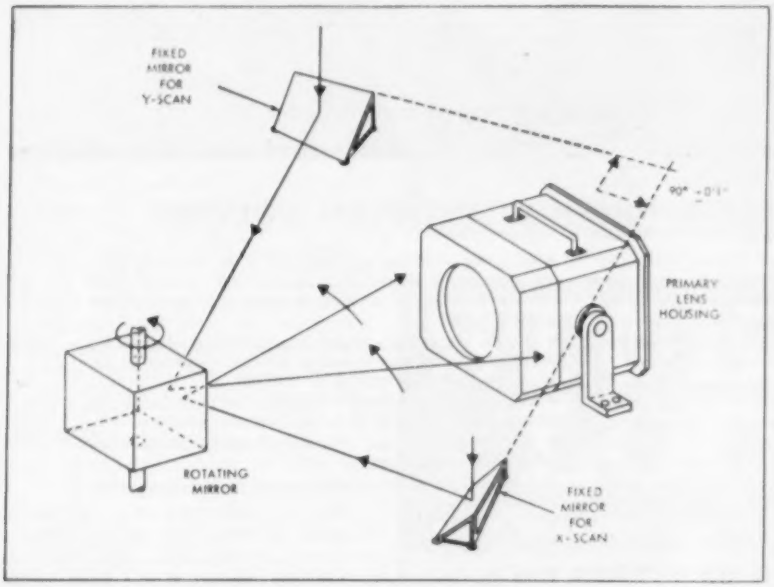
Radiation, Inc., Melbourne, Fla., will develop the design of the tracking system under an Air Force study contract. SORTI, utilizing star positions for orientation reference, attempts to combine the accuracy of ballistic camera tracking with the instantaneous readout of real-time systems. Desired accuracy of the system is one second of arc at 20-per-sec. repetition rate.

The present SORTI concept calls for an electronic-optical-mechanical system. In the focal plane of a ballistic camera lens is a narrow slit forward of a photomultiplier detector tube. A rotating mirror effects alternate scans of the sky in the X and Y planes. A clock tied to the mirror rotation counts increments of angular measurement and its output is governed by the detector tube to provide an accurate reading of the angular displacement between two celestial light sources—the missile and a known star. The true angular position of the star at any instant of time will be calculated by an IBM 7090 computer. The SORTI system is intended to provide accurate missile location with a minimization of errors caused by atmospheric refraction and instrument misalignment.

FILTER CENTER

▶**Minuteman Component Reliability Backup**—Autonetics is seeking semiconductor sources to provide transistors as a backup for those being supplied to its Minuteman guidance and control system reliability program (AW Oct. 19, 1959, p. 69) by General Electric, Motorola, Fairchild, Transitron, and Delco. Additional suppliers must consent to same stringent manufacturing and reliability control as do present Minuteman component subcontractors. Backup for diode sources is being considered.

▶**Tacan Reliability Increased**—Hoffman Electronics reports that airborne Tacan sets it is delivering to Air Force now exhibit 150 hr. mean-time-between-failure (MTBF) when subjected to the rigorous AGREE test program. The Hoffman ARN-21C becomes the first complex equipment to hurdle the tough AGREE tests under which earlier model Tacan equipments showed only 17½ hr. between failure. In field use, equipment is expected to exhibit considerably longer MTBF (AW June 13, p. 57).



PRESENT concept for SORTI instrument under development by Radiation, Inc. is shown schematically. Method permits accurate missile location with minimum error caused by atmospheric refraction, instrument misalignment, etc.

▶**Bay Area R&D Expanding**—San Francisco Bay area continues to be an attractive location for avionics and space technology companies. Arthur D. Little, Inc., Cambridge, Mass., research organization active in several space programs, is now shopping for land for a research facility on the Bay peninsula. Until now, Little's only representation on the West Coast was provided by consulting offices. One of the newest outfits on the peninsula is the recently organized U. S. Systems Development Laboratory in Palo Alto, formed by a small group of infrared specialists previously with Itek in Palo Alto.

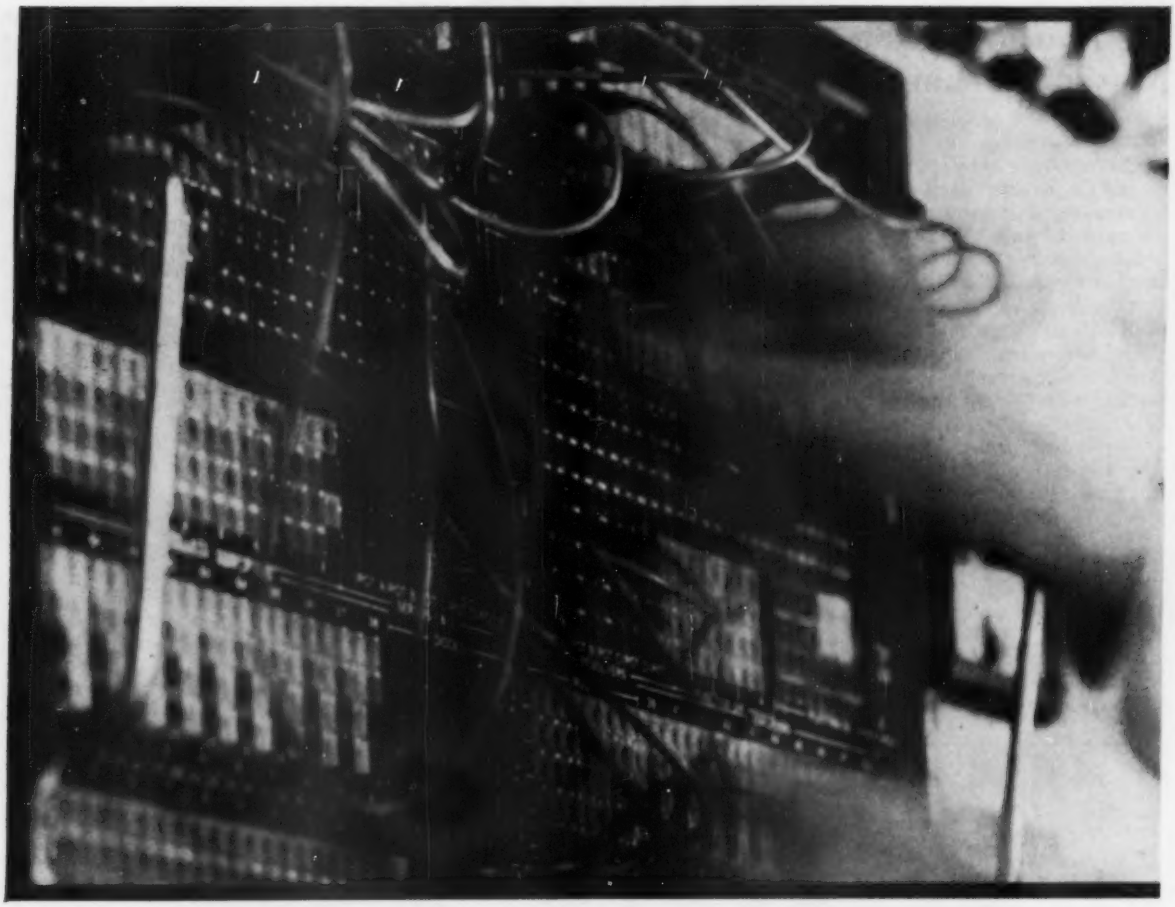
▶**Transistor Sales Trend Continues**—Transistor sales for July were 7.1 million units, an increase of only 12% over the same month of 1959 compared with a 120% increase in transistor sales in July 1959 over same month in 1958, according to Electronic Industries Assn. figures just released. Dollar sales in July this year were $18.1 million, 12% higher than the previous year. By way of comparison, dollar sales in July 1959 were 180% higher than in July 1958. Latest figures confirm semiconductor market saturation trend first spotted by AVIATION WEEK when April sales figures were released (AW Aug. 1, p. 75).

▶**First Antenna Breakdown Study Set**—First of three Nike-Cajun rocket firings which will carry instrumented studies conducted by Stanford Research Institute is scheduled for firing at the Eglin Gulf Test Range (AW Sept. 19, p. 63) in late October. In addition to equipment for a propagation study, the rocket will carry over-powered X-band and UHF transmitters in an effort to study antenna breakdown in upper atmosphere.

▶**Infrared Filter Range Extended**—Infrared interference filters with sharp cut-off that can be placed anywhere between 1½ and 8 microns, and eventually may be extended out to 16 microns or beyond, has been developed by Spectracoat, Inc., Belmont, Calif. Company says that filters pass at least 60% of the radiation in their passband but less than 1% in their rejection band. The filters make it possible to detect and discriminate between objects having very small temperature differentials over the temperature range of −160C to 110C.

▶**New Photo-emissive Material Developed**—Photo-emissive material, for imaging and photomultiplier tubes, which maintains a high sensitivity for many hours at operating temperatures of 250F, raising the top temperature limit at which such tubes can be operated, has been developed by Westing-

DYSTAC*



A MAJOR BREAKTHROUGH IN PROBLEM SOLVING

*DYSTAC: Dynamic Storage Analog Computer, developed by CSI, incorporates high-speed repetitive capabilities with dynamic storage of analog data to an accuracy of 0.01% and with a time-base accuracy of ±0.5 microsecond. This development has tremendously increased the versatility, economy, and speed of solution associated with analog computers.

DYSTAC provides unique time-sharing of computer components and high speed reiterations. These features make possible economic and rapid solution of complex problems that have required too many computer components or too long a solution time to be considered practical for either digital or analog techniques. Different combinations of this new development readily solve problems in four broad categories.

- Sequential calculation, as encountered in the distillation problem. Here, successive solutions to algebraic matrices are obtained from cycle to cycle at a repetitive speed of 60 cps until the problem is solved.
- Definite integral calculations. Varying definite integrals are evaluated from one cycle to another and held in memory for the successful solution of optimization problems.
- Rapid evaluation of multiple integrals. This technique can be employed for the solution of partial differential equations.
- Transient problems and difference-differential equations are solved with continuous memory.

For complete information or to arrange for a demonstration write, phone, or wire:

COMPUTER SYSTEMS, INC., Culver Road, Monmouth Junction, N. J. • DAvis 9-2351

A Schlumberger Subsidiary • formerly Mid-Century Instrumatic Corp.

house Electric. The material, consisting of sodium, potassium and antimony, has been applied as a semi-transparent surface on a glass substrate and has exhibited photo-response values up to 80 microamps per lumen. Material was developed under Navy Bureau of Ships sponsorship.

▶**Handy Chart On Computer Characteristics**—Extremely useful compilation of important characteristics of some 43 digital computers now on the market has been prepared by Adams Associates, data processing equipment consulting firm. Computers range in size from the large IBM 7030 (Stretch) to the small Monobot XI. Chart includes such data as price, storage capacity, word size, instruction addresses, add time, access time, plus data on available external storage, input and output devices. The company expects to supplement this chart periodically. Copies of the computer characteristics chart can be obtained by writing to Adams Associates, 142 The Great Road, Bedford, Mass.

▶**Defense Electronics Growth Slows Up**—Growth of military electronics market, which has risen an average of about 20% every year since the end of the Korean War, is expected to taper off to an estimated 9% growth for next five to 10 years, according to Electronic Industries Assn. Prediction is based on survey of more than 50 members of EIA's Military Marketing Data Committee. The group estimates defense electronics spending this year at about $5 billion. Supplementing this will be another $130 million in electronic hardware expenditures by Federal Aviation Agency and an estimated $100 million of the National Aeronautics and Space Administration's $915 million total budget, Electronic Industries Assn. says.

▶**Call for Papers**—Call for prospective authors for the following technical conferences has been issued:

• **Winter Convention on Military Electronics,** Feb. 1-3, Los Angeles. Series of "Condential" (classified) sessions will be included: Send 100-word abstracts and 500-word summaries by Nov. 15 to Dr. John J. Myers, Hoffman Electronics Corp., 3717 South Grand Ave., Los Angeles 7, Calif.

• **Fifth Midwest Symposium on Circuit Theory,** May 7-8, University of Illinois, Urbana, Ill., devoted exclusively to network topology and graph theory including active and passive networks, information networks and switching circuits. Send complete manuscript by Oct. 1 to: Prof. M. E. Van Valkenburg, Dept. of Electrical Engineering, University of Illinois, Urbana, Ill.

NEW BALANCED WAVE TIG WELDER DELIVERS DEEP, CLEAN "X-RAY" WELDS ON SHEET METAL or PLATE

miller

• A bold new concept in electrical design and circuitry is introduced in the all-new Miller BWC-300MAP. One of several notable results is complete and automatic elimination of the d-c component at all welding currents . . . an essential in certain critical welding applications.

• Due to the specially designed transformer, high arc initiation voltage and unique circuit, arc-outages cannot occur.

• "Fail-safe" voltage reducer automatically lowers the high arc initiation voltage to a low open circuit voltage — even in case of malfunction of the reducer.

• Five independent welding ranges with overlap offer an infinite number of positive, fine current settings — another characteristic of Miller's electrical control that speeds up and simplifies critical welding jobs.

EXCLUSIVES! — found only in new Miller BWC-300MAP:

1. Perfect balance throughout the entire welding range EVEN DURING CRATER ELIMINATION.
2. Arc stability WITHOUT HIGH FREQUENCY at as low as 18 amperes.

The outstanding versatility of this welder, and the specifics on its various features, are detailed fully on our form #BW-3 — a copy of which will be sent to you promptly upon request.

miller ELECTRIC MANUFACTURING COMPANY, INC. • APPLETON, WISCONSIN
Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

STUKE LOCK
PATENTED
CLIP-LOCKING TURNBUCKLES

MORE POSITIVE! Action of Stukes completely eliminates rotation found in lock-wired turnbuckles.

Associated Aircraft Industries
2600 poplar avenue memphis 12, tenn.

WARNING
1. READ INSTRUCTIONS BEFORE TESTING.
2. TEST VOLTAGE BETWEEN "C" TERM. &
GROUND NOT TO EXCEED 110 VOLTS.
3. OPERATING VOLTAGE MUST LIE
BETWEEN 18 AND 31 VOLTS AT MOTOR
LEADS OR 19.5 AND 32.5 AT
KINETICS CORPORATION
SOLANA BEACH, CALIFORNIA
SWITCH: TEST & CALIBRATION
TRANSFER

Kinetics 100-pole, double-throw, 15-amp switch occupies only 45 cu. in.

This rugged, dependable electric motor drives the contacts in the new Kinetics 100-pole, double-throw, 15-amp switch, insuring reliable operation under extreme vibration and acceleration conditions.

For space craft and missile applications, Kinetics Corporation has developed a new switch that combines maximum reliability with extremely high density construction for the most circuits in the least space. The new 100-pole, double-throw switch measures only 5.1" x 2.7" x 3.2". Each switch contact can carry from microamps to 15 amps, continuously. The unit weighs approximately 5 lbs.

The Kinetics switch is motor-driven for maximum reliability. There are no permanent magnets or springs, no latching devices, no other relay elements of any kind to cause trouble. The switch can be transferred at 40 G's, 2000 cycles. Once it's transferred, no power is required to hold it in position, saving batteries. The switch exhibits no contact chatter over the whole vibration spectrum, from 5 to 2000 cycles, 40 G's. Voltage drop across contacts is less than 10 millivolts at 15 amps.

This new Kinetics switch lends itself to many space craft and missile applications. Instrumentation, a-c and d-c power, destruct circuits and others may all be accommodated in one switch. A typical application would be the transfer of guidance, telemetry and control signals from one stage to another in a multi-stage missile.

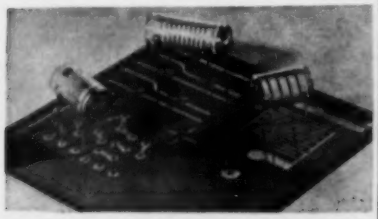
Kinetics' switches are used on the major missile and space craft programs where maximum reliability under rigorous environmental conditions is essential. For help with your switch requirements, write or phone Kinetics Corporation, Dept. KA-10, 410 S. Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

KINETICS CORPORATION

ELECTRONICS · ELECTROMECHANICS

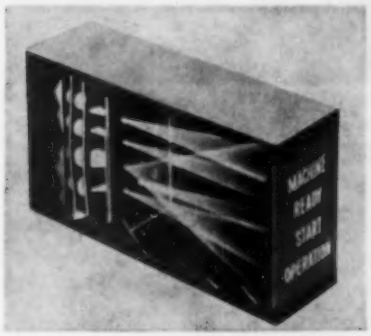
NEW AVIONIC PRODUCTS

• **Inductors** for printed circuit board use, now available in 26 models with wire leads, have outside diameter of 0.46 in., temperature coefficient of less than +20 ppm/C. Range of inductance is 0.05 to 2 microhenries with



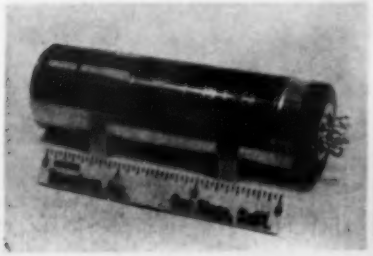
"Q" values ranging from 120 to 250. Operating temperature range is −55C to 125C. Inductors are suitable for operating at frequencies from 10 to 250 mc. Manufacturer: Corning Electronic Components Department, Corning Glass Works, Corning, N. Y.

• **Digital display,** Series 80,000, can display any combination of up to 12 words with choice of five colored backgrounds against which it is displayed: red, orange, yellow, green or blue.



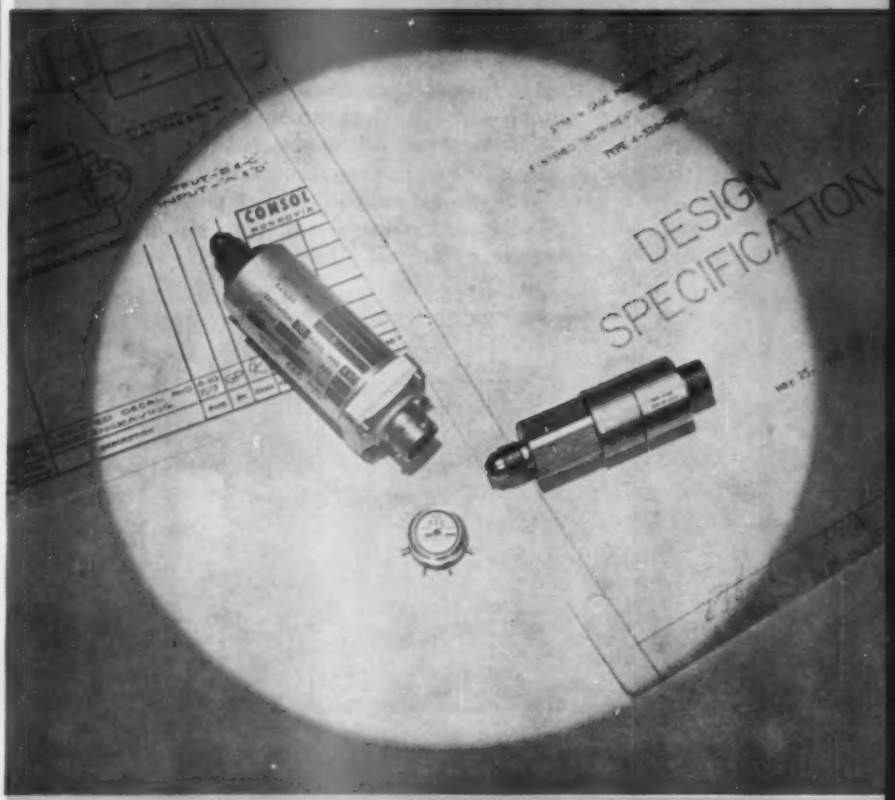
Selection of appropriate lamps to be illuminated selects corresponding words and/or colors. Device measures approximately 3¼ x 5¼ x 12 in., weighs less than 4 lb. Manufacturer: Industrial Electronic Engineers, Inc., 5528 Vineland Ave., North Hollywood, Calif.

• **Miniature rate gyro,** operating from 28 vdc. measures 1⅛ in. diameter and 3¾ in. long, weighs 8 oz. Gyro hysteresis is 0.5% maximum and accuracy is



THE SPOTLIGHT'S ON PERFORMANCE

with CEC's newest strain gage pressure transducers



And the accent's on versatility! As a family, these three cover a pressure range from 0 to 10,000 psi in gage, absolute, and differential models...always provide top performance, even in applications with great extremes of environmental conditions.

Above, TYPE 4-325 is the smallest—only 8 grams—and extremely valuable where size is critical. Differential models cover the range from ±5 to 50 psi, while absolute and vented gage units measure pressures from 10 to 200 psi. Write for *Bulletin CEC 1630-X6.*

Outstanding TYPE 4-326 has the finest inherent performance capabilities of any comparable product now manufactured. It's rugged—usable in a 1000 g environment—and measures absolute and gage pressures from 0 to 10,000 psi. Write for *Bulletin CEC 4326-X2.*

New TYPE 4-328 has a built-in thermal heat shield, making it ideal for airborne applications. Sealed gage and absolute models are available for low, medium, and high-pressure measurement. *Bulletin CEC 4328-X2.*

Other strain gage pressure transducers in the CEC family are described in *Bulletin CEC 1308-X23.*

Transducer Division CEC

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

A SUBSIDIARY OF Bell & Howell · FINER PRODUCTS THROUGH IMAGINATION

Barber-Colman temperature controls chosen by leading makers of ground support equipment

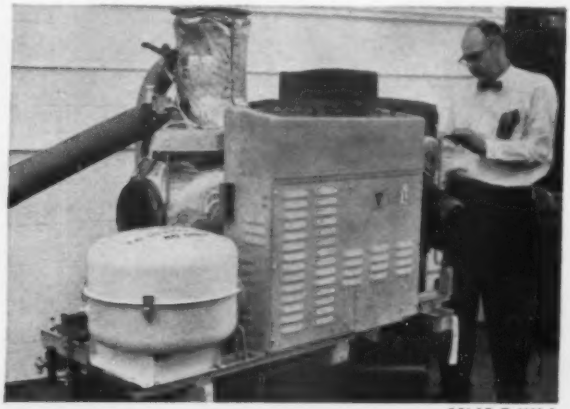
Today's air and space vehicles call for a growing array of ground support equipment. Shown below are a few examples of support units employing Barber-Colman temperature control systems. Components used include: control boxes, actuators, valves, temperature sensing elements, and thermostats. The systems are specifically engineered for each application through the teamwork of the ground cart manufacturer and Barber-Colman. For help on your ground support control projects, consult the Barber-Colman engineering sales office nearest you: Baltimore, Boston, Fort Worth, Los Angeles, Montreal, New York, Rockford, Seattle.

TYPICAL FUNCTIONS BARBER-COLMAN GROUND SUPPORT CONTROL SYSTEMS

Controlling temperature of missile guidance compartments and shrouds.

Controlling temperature of missile measurements compartments.

Controlling preflight cabin temperature of jet tankers . . . and many similar precision applications.

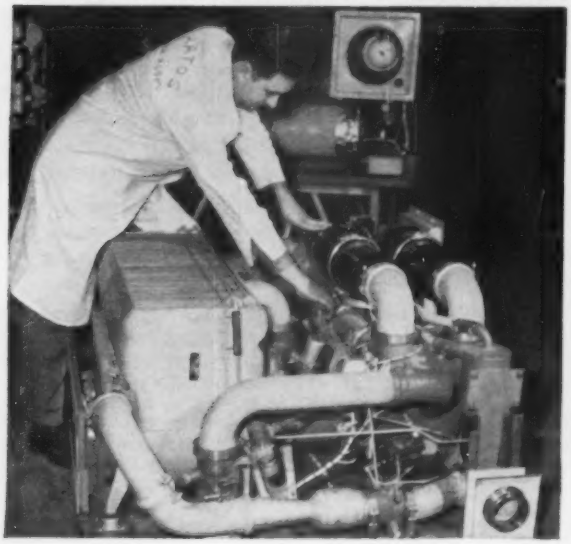


SOLAR T-41M-9

STRATOS DIVISION—FAIRCHILD ENGINE & AIRPLANE CORP. GEA 120-1

AMERICAN AIR FILTER CO.—DEFENSE PRODUCTS DIVISION C-10

C. G. HOKANSON COMPANY—MODEL 798



THE MARK OF QUALITY

BARBER COLMAN

BARBER-COLMAN COMPANY

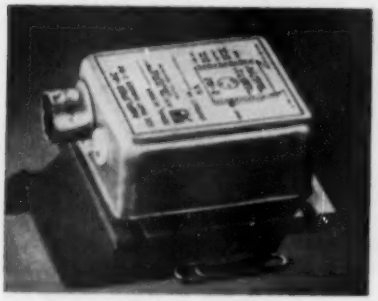
Dept. J, 1422 Rock Street, Rockford, Illinois

AIRCRAFT AND MISSILE PRODUCTS: AIR VALVES, ELECTROMECHANICAL ACTUATORS, TEMPERATURE CONTROL SYSTEMS, POSITIONING SYSTEMS, TRANSDUCERS AND THERMOSTATS, SPECIAL GROUND TEST EQUIPMENT

A SUBSIDIARY OF Bell & Howell · FINER PRODUCTS THROUGH IMAGINATION

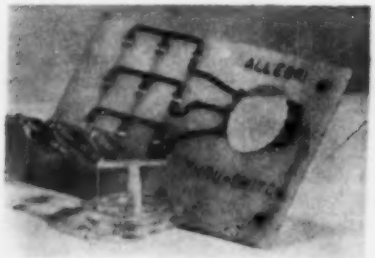
1%, according to manufacturer. Unit is hermetically sealed and has service life of more than 300 hr. Manufacturer: Humphrey, Inc., 2805 Canon St., San Diego 6, Calif.

• **Telemetry a.c. signal amplifier,** Type 2-182, for amplifying output from crystal accelerometer. Gain is adjustable from ½ to 50. Response is 5 cps. to 4 kc. Output is 2½ v. Silicon transistors are used throughout. Also available: time-of-event marker, Type 2-164A, an ultra



linear ramp generator. Nominal ramp slope is 0.05 v./ms. but unit is available with other values. Output is 6.5 v. Device also uses silicon transistors and is qualified for ballistic missile environment. Manufacturer: Electro Development Corp., 3939 University Way, Seattle 5, Washington.

• **High-power voltage-tunable magnetron,** Type Z-5424, has minimum CW power of 50 watts over entire frequency range of 2.9 to 3.2 kmc. Similar voltage-tunable magnetrons can be designed for 300 mc. bandwidths anywhere in the 2 to 4 kmc. region, manufacturer says. Device is a complete RF package, requiring only input and output power connections. Tuning rate is about 1½ mc./volt and plate efficiency is 55% to 60%. Net weight is 4½ lb. Manufacturer: General Electric Co., Power Tube Dept., Schenectady, N. Y.



• **Integral printed circuit switch,** called "Thru-Switch," is built into printed board utilizing board's conductors. As many as 20 circuits can be switched through a 1 in. diameter hole. Up to 10 switching wafers per inch can be ganged by stacking printed circuit boards. Manufacturer: Allied Allegri Co., 141 River Road, Nutley 10, N. J.

COMMUNICATION HELMET TYPE 13500
AIRSCREW HEADSET TYPE 13600
AIRSCREW HEADSET TYPE H.23
AIR-TRAFFIC-CONTROL HEADSET TYPE L.324
AIRSCREW HEADSET TYPE H.21
CAMERA CONTROL HEADSET TYPE L.213

Headsets
and other products

Communication Systems · Headphones and Headsets
Earphone & Microphone Inserts Communication Helmets
Stethophones · Microphone Assemblies · Ear Defenders

AMPLIVOX LIMITED
INDUSTRIAL DIVISION
Wembley England

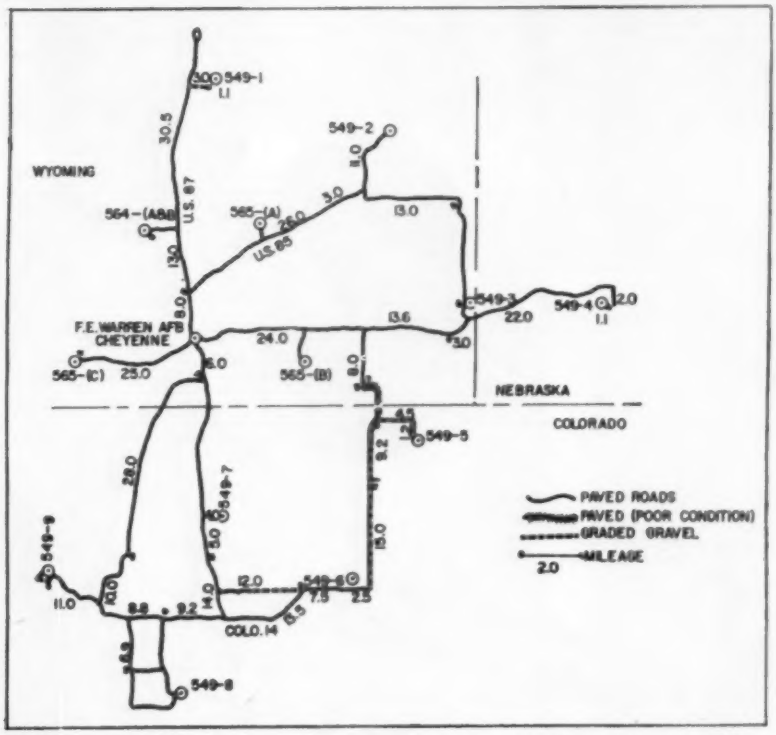
assignment: Super Service on a Quality custom installation job!
place order with: EAS!

When YOU need Super Service for a Top Quality custom installation job — YOU deserve the Best, too! Remember to call . . .

EXECUTIVE AIRCRAFT SERVICE, inc.
REDBIRD AIRPORT • DALLAS, TEXAS
EAS
L. V. Emery, Pres.

HELIO L-28 Super Courier (left) and the Sikorsky H-19 are two of the aircraft competing for missile support roles at Warren AFB. The evaluation may result in purchase of a mixed fleet of up to 200 STOL fixed wing and rotary wing aircraft.

USAF Evaluates Aircraft for Missile



MAP shows the relative location of the launch sites of the 706th Strategic Missile Wing. First two units, the 564th with six missiles on one site and the 565th with three missiles on each of three sites, do not pose a serious transportation problem. The nine sites of the 549th, however, are widely dispersed and will be virtually inaccessible at certain times in the winter. Nearly 800 mi. of road travel is necessary to visit all sites by surface transportation. Rotation of crews is greatest problem, due to number of personnel involved. Transportation for inspecting officers, doctors and maintenance personnel also is required.

By William S. Reed

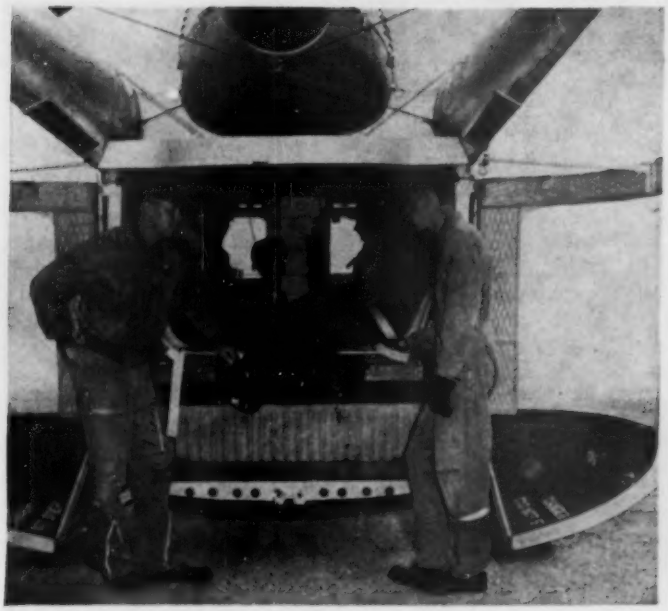
Warren AFB, Wyo.—Helicopter and light, fixed-wing aircraft manufacturers are competing for orders for missile site support aircraft which soon will be placed as a result of a survey currently being conducted here by the Strategic Air Command. Probable outcome of the survey will be a recommendation to purchase a mixed fleet of up to 200 STOL fixed wing and rotary wing vehicles.

Among the light aircraft and helicopters being evaluated are:

- **De Havilland L-20,** Cessna 182, Helio Courier L-28, Lockheed LASA 60.
- **Sikorsky H-19,** Bell HU-1, Kaman H-43B and Republic Alouette.

The transportation requirement study being conducted is not confined solely to aircraft but will consider surface transportation as well. In some instances, because of time, size or weight of cargo, etc., airlift will not be feasible. SAC transportation officers estimate that surface vehicle travel requirements will amount to about 4 million road miles annually, necessitating replacement of equipment every three years instead of the Air Force norm of five years. Estimates as to the number of aircraft required and their daily utilization could not be made because of insufficient data.

A SAC team studying missile site support transportation requirements is headed by Lt. Col. R. C. McCloskey



KAMAN H-43B loads combat defense troops for airlift to scene of a simulated nuclear incident 11 min. from Warren AFB. At right the helicopter, carrying six soldiers and two pilots, hovers at an elevation of 6,100 ft. msl. with air temperature at 65F.

Site Support

and consists of four majors, and six senior non-commissioned officers, all experienced in supporting base transportation requirements. They have set up a central transportation control center in the Warren command post through which all requests for, and dispatches of, air and surface transportation are made. Elaborate methods are used to record each movement so that the data can be transposed onto punch cards and fed into a computer for analysis.

Transport Factors

Consideration of the transportation requirement to support the 13 sites around Cheyenne involves the following factors:

• **Air distance between** the Warren command post and the sites range from 13 to 50 naut. mi. Probably the most accessible site is the one on which the six missiles of the 564th Squadron are deployed. It lies 15 air miles from the Warren command post and only 21 road miles. But, since construction started on this site, the trend has switched to more widely dispersing individual missiles. The 1 x 6 deployment at the 564th will not be repeated elsewhere at any SAC base. The nine missiles deployed in three sites of the 565th Squadron (3 x 3) also are readily accessible from the Warren command post. Closest is 13 mi., farthest is 18 air mi. and both are 25 road mi. from the base.

The nine sites now under construction which will house one missile each pose the most critical problem for physical communication. Closest to Warren is No. 7 which lies 22 mi., by air and 13 mi. by road. Farthest of the 549th (1 x 9) sites is No. 14 which is 50 air mi., 67 road miles from Warren. At this time, only educated guesses are available as to the frequency with which these sites will have to be visited once they become operational. Initially, frequency of visits will be high, tapering off as crew experience increases.

• **Highway network connecting** the Warren command post with the 13 sites varies from four-lane super highways to graded, gravel roads passable only in summer. Again, the best highway communication exists between the four sites composing the 564th and 565th Squadrons. The sparsely populated and virtually isolated sites on which the missiles were placed did not demand heavily traveled super highways, nor was it feasible to locate the sites, because of real estate acquisition, close to good highways in all cases. Worse than the travel between command post and site is the problem on site-to-site travel. In many cases, roads between sites are non-existent or passable only during the summer months.

• **Terrain of the sites ranges** in elevation from 4,900 to 7,300 ft. mean sea level. The normally unaspirated engines of most helicopters and light aircraft become critical near this altitude. During hot summer days, it is not uncommon for density altitudes of 9,000 ft. to prevail in the Cheyenne area. Hovering capability of many helicopters be-

Strategic Missile Squadron	Site	No. Of Missiles	From F. E. Warren AFB Air Miles (Naut.)	Road Miles (Stat.)
564th	A&B	6	15	21
565th	A	3	18	24
"	B	3	15	24
"	C	3	13	25
549th	1	1	37	47
"	2	1	37	46
"	3	1	35	47
"	4	1	50	67
"	5	1	31	49
"	6	1	37	62
"	7	1	22	31
"	8	1	44	67
"	9	1	49	63

DISTANCES of strategic missile squadron sites from Warren AFB by air and by road.

Navy Sub-Hunters

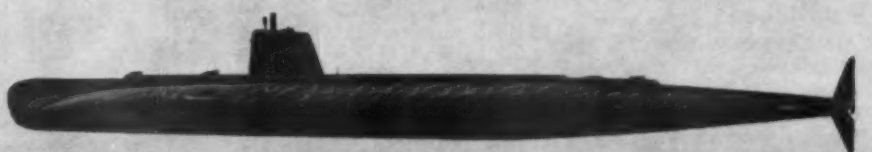
guided by Ryan C-W doppler navigation

No weapon is more elusive than the modern submarine. For the vital task of detecting these underwater craft, the Navy equips almost every type of anti-submarine aircraft with today's most advanced *proven* type of aerial navigation—Ryan continuous-wave doppler systems.

The world's leader in the design and manufacture of continuous-wave doppler systems is Ryan Electronics. In production are Ryanav* doppler navigation systems which provide complete, accurate navigation information in all weather conditions, over water or land. And, equally important, this information is supplied without the aid of ground stations or outside data.

This is why—in bombing, reconnaissance, mine-laying and airborne-early-warning missions as well as in submarine detection—many Navy aircraft are guided by Ryanav doppler systems from Ryan Electronics.

Ryan Electronics is at work in many fields, creating advanced equipment for today's aircraft and preparing for the navigation and guidance of the space vehicles of tomorrow. In Electronics, too—Ryan Builds Better.



*Trademark

RYAN ELECTRONICS

DIVISION OF RYAN AERONAUTICAL COMPANY • SAN DIEGO, CALIFORNIA

RYAN BUILDS BETTER

comes nonexistent at this density altitude.

• **Winter weather** at Cheyenne generally is severe. Snow is the rule rather than the exception and strong surface winds normally accompany snows piling up in huge drifts. During one snowstorm in recent years, the base, which lies on the outskirts of Cheyenne only about two miles from the center of town, was isolated for three days.

Flying weather also is considered since Cheyenne lies in an airways control zone necessitating instrument clearance during bad weather. VFR minimums for fixed wing aircraft require 1,500 ft. ceilings with 3 mi. visibility. For helicopters, VFR conditions can be maintained with 700 ft. ceilings and one mile visibility.

Most sites are surrounded by rolling terrain which does not lend itself readily to construction of airstrips, even though only about 3,500 ft. maximum is required. A strip is under construction near Warren and also at the sites of the 564th Squadron, already operational.

However, the strips are and will be restricted to daylight VFR operations since the installation of control facilities, obstruction lights, runway lights, and the problems of snow removal during winter become impractical.

Basic Requirements

SAC has established seven basic requirements justifying aerial transportation between command post and site and from site to site.

• **Combat command.** Commander of the 565th Squadron with its 3 x 3 site located relatively close to Warren could visit each crew once every 10 days if he drove every day of the week. Commander of the 549th, with its more widely dispersed 1 x 9 sites could visit each crew once every 20 days. SAC also points out that it is highly desirable that the Director of Weapon Systems, a combination maintenance and operations officer, be able to visit the sites regularly and frequently.

• **Rotation of personnel.** The rotation of personnel to the 564th site, closest of the 13, on an 8-hr. basis already has been tried and abandoned. SAC presently is running 12-hr. shifts and soon will try 24-hr. and 48-hr. on-station times. It is quite possible, according to Deputy Wing Commander Col. R. D. Samson, that crews will be at the site for 48 hr. at a stretch. Two crews will be on each site at all times and a new crew will arrive each day. Making the round trip by surface transportation once each day will impose less of a load on the base transportation facilities and will result in each crew spending less time in transit. Squadrons of the 564th and 565th are manned by 16-man crews plus a powerplant specialist. Rotation of this many people by air does not appear feasible. However, the four-man crews of the 549th possibly will be rotated by helicopter.

• **Medical attention.** Advantages of being able to quickly return an ill crew member to the base and replace him with another crewman are obvious. Doctors and medical technicians are in critical shortage in the Air Force and cannot afford the long hours of travel by surface means necessary to attend an emergency at a remote site.

• **Security surveillance.** Possibility of sabotage or other subversive activity in the vicinity of the sites and along the routes over which missiles, warheads and other critical parts may travel can be considerably diminished by providing air surveillance ahead of the movement of such parts. Additionally, reinforcements of trained defense forces can be quickly brought into play in the event of a nuclear mishap.

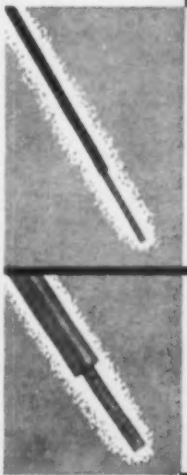
• **Parts** within the cubage and weight-carrying capacity of helicopters or light aircraft, can be expeditiously delivered to reduce out-of-commission time. Whenever possible, SAC intends to deliver parts on a regularly scheduled basis, but should an MOCP occur (missile out of commission for parts), it is essential that the parts be delivered as quickly as possible since the goal is

Electrically Heated Rubber Controls Ice

B.F.Goodrich fabricates rubber units with integral electrical heating elements for bonding to complex curves and odd shapes as well as flat surfaces. These units control ice formation in localized areas such as air intakes, cowls, propeller blades and spinners. Elements are thin; can be applied underneath skin or externally.

B.F.Goodrich
aviation products
Dept. AW-10B, Akron, Ohio

LEWIS WIRE PRODUCTS



TEFLON* INSULATED HOOKUP WIRE, −90°C to +250°C
MIL-W-16878B, TYPES E and EE

For Missiles, Computers and Electronic Assemblies

Miniaturization and complex electronic assemblies are simplified with the use of Teflon insulated wire. It is unaffected by soldering-iron temperatures, has a low coefficient of friction and will not heat-age as it contains no plasticizers to cause failure due to brittleness. Resistant to chemicals and solvents, Teflon insulated wire provides superior dielectric strength with minimum wall thickness. Manufactured with silver coated copper conductor in 600 volt and 1000 volt ratings in A. W. G. sizes from 32 thru 10.

600 VOLT AIRCRAFT WIRE TO MIL-W-7139A

A qualified product for high temperature applications requiring superior solvent resistance, high insulation resistance and circuit reliability.

Silver coated copper conductor, insulated with Teflon and Teflon-glass tapes, covered with a Teflon-glass braid having a Teflon finish. Manufactured in A. W. G. sizes 22 thru 4/0, also available in sizes 6 thru 22 with a type 302 stainless steel braid applied over all.

* Dupont trademark

The LEWIS ENGINEERING CO
Naugatuck, Connecticut
WIRE DIVISION

Specialists in High Temperature Wires and Cables

U.S. AIR FORCE

Nav Aid exam 8 miles high

first assignment for the Air Force's new C-140 JetStar

America's ability to be constantly ready for strategic and tactical action throughout the free world is linked directly with the accuracy and reliability of our military navigational aids and air traffic control facilities. Now the Air Force has a high-flying electronics lab that can evaluate these aids realistically under operational jet flight conditions. Name of the plane – C-140 JetStar, made by LOCKHEED/GEORGIA.

Five of the new C-140's will go into service soon with the Airways and Air Communications Service arm of MATS. This important assignment is the first operational military role for the JetStar, which was developed by Lockheed to meet the Air Force's need for a multi-mission jet aircraft.

The JetStar operates nimbly in the high-altitude military traffic layer. With four Pratt & Whitney J-60 turbojets placed well back on the aft fuselage – behind the eardrums of the crew – the C-140 JetStar achieves Mach .8 cruising speeds. But the new C-140 is more than just quick and quiet. It's a stable platform that assures the accuracy of the sensitive electronic evaluating equipment. And the entire airplane is pressurized and air-conditioned to provide a comfortable working environment for both crew and equipment.

LOCKHEED

GEORGIA DIVISION • MARIETTA, GEORGIA

MINIATURE 2-WAY RADIO SYSTEM Keeps YOU in CONTACT in ANY Situation; ANY TIME, ANYWHERE!

the SEISCOR TELEPATH

. . . is a portable industrial quality communications system that becomes a part of your wearing apparel. It is engineered for short-range applications where dependability and convenience of use are essential. Precision circuit and durable construction provide extremely low maintenance and trouble-free operation!

- **Fully transistorized printed circuit**
- **Crystal-controlled superheterodyne receiver**
- **Crystal-controlled transmitter**
- **Long battery life**
- **For any single frequency between 29-55 mc., A.M.**
- **No license required on 27 mc. units.**

MODEL HR
Hardhat with built-in transceiver, antenna, earphones and mike. High and low noise level models available.

MODEL BR
Belt-clip transceiver and headset with built-in antenna, earphones and mike. High and low noise level models available.

Let Seiscor Engineers analyze your short-range communications problems. Example: Special units have been designed into protective clothing for crash-crew fire fighters.

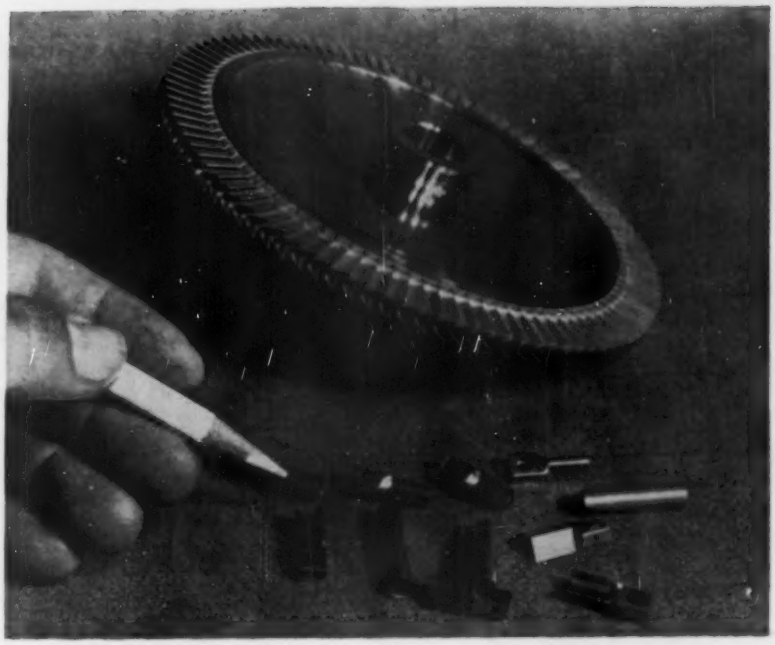
FIND OUT TODAY HOW TELEPATH CAN IMPROVE YOUR SHORT RANGE COMMUNICATIONS!

Write for name of nearest TELEPATH dealer, and complete information on versatile TELEPATH communications.

SEISCOR

A DIVISION OF SEISMOGRAPH SERVICE CORPORATION

BOX 1590, TULSA, OKLAHOMA



Turbine Wheel Uses Sheet-Metal Buckets

Lightweight turbine wheel using sheet-metal buckets instead of conventional cast blades has been developed by General Electric's Aircraft Accessory Turbine Department for a fuel pump on the company's J93-3 turbojet. Design conditions for the wheel included operation in air temperatures above 1,000F up to 1,000 hr. without maintenance. Use of sheet-metal buckets saved more than 2 lb. in the 18-lb. unit, and cut cost by more than half. Turbine wheel and shroud can also be designed lighter as a result, and the low inertia of the rotor can simplify control mechanization, GE engineers say. Reliability meets or exceeds the standards for small cast-turbine wheels. Blades formed are constant-chord and untwisted; twist, taper or higher temperatures will require additional development work.

to maintain all missiles combat ready on a 24-hr. basis.

• **Maintenance specialists.** Remote sites of the 549th with only four-man crews will rely heavily on traveling maintenance specialists to perform periodic and unscheduled maintenance. Travel between sites of such specialists will be greatly facilitated if air transportation is used.

• **Inspection teams.** Inspections can be expedited and can be conducted more often to ensure instant readiness if such teams are not bound by the slow schedule demanded of surface transportation.

Hypothetical Case

Taking a hypothetical case to illustrate the distance involved, if a new part of a critical nature had to be delivered to each of the 13 sites, the round trip air distance would be approximately 806 naut. mi. If the same part had to be delivered to each of the 13 sites by surface means, the total round trip distance would be 1,146 mi. If an average speed of 100 mph. is considered for a helicopter or light fixed wing aircraft, approximately 8 hr. flying time is involved. But if surface transportation averages 30 mph.—and this would be considered highly improbable in winter over poor roads—more than 38 hr. driving time would be required. It is not inconceivable that during winter months, a site might be inaccessible by road for a period of several days.

An example of how helicopters can effectively be utilized in the security and surveillance role was graphically demonstrated here when a simulated nuclear incident was staged. SAC-wide code name for such an incident, whether it involves the crash of an aircraft carrying a nuclear weapon or a minor ground incident occurring during movement of a weapon, is "Broken Arrow."

The simulation commenced with the placement of a smoke bomb near the intersection of two roads close to the access road for the operational 564th Squadron. Word was passed to the ready room of the 389th combat defense squadron, a force composed of 209 enlisted men and four officers, at 1:30 p.m. Six armed combat defense force troops arrived at the helicopter landing pad near the control center, climbed on board a waiting Kaman H-43B Huskie and were airborne at 1:35 p.m.

At 1:46 p.m. the Huskie landed on a

dirt road near the simulated disaster and the six airmen fanned out to establish a perimeter defense 1,500 ft. from the location. Had this been an actual incident, the troops would have sealed the area off from curious spectators until a team of decontamination and bomb disposal experts arrived.

After maintaining the perimeter for 15 min., the combat defense forces returned to the H-43B and were flown back to Warren, where they again went on alert.

The combat defense forces are responsible not only for providing security for incidents such as "Broken Arrow," but provide for 24 hr. security around the missile sites, the Missile Assembly Building and other security areas, and escort all missiles and warheads to and from the sites. In the latter escort operation, helicopters are especially valuable to scout ahead of convoys if it is deemed necessary because of possible sabotage attempts.

Deadline for the transportation team to finish the evaluation is Oct. 16, but it is possible that the test may be extended if the need for data during operation in the winter months is required. A pattern is beginning to emerge from the schedules kept by the SAC team which shows that central control over all base transportation, both aerial and surface, is essential if proper utilization is to be obtained. Flights by the assigned aircraft increase at a steady rate and more aircraft could be used if available. Maximum so far has been 15 flights with three H-43Bs, two H-19s, two L-20s, and a Helio Courier which was not yet in the operation, having just arrived.

Maintenance on the aircraft participating in the evaluation is one problem which is not resolved. The Air Force has all maintenance done on a

Mirage IV Record

Paris—Dassault Mirage IV twin jet strike bomber reportedly covered a 1,000 km. closed circuit course at record average speed of 1,820 km./hr.

New speed record has been filed with the Federation Acronautique Internationale (FAI) for authentication. Current record of 1,126 km./hr. for the 1,000 km. category was set Apr. 8, 1959, by USAF Col. E. H. Taylor flying a McDonnell RF-101C.

Dassault test pilot Rene Bigand flew the record flight over a course which circled Paris. Mirage IV, of which only one prototype is flying, is powered by two SNECMA Atar 9 afterburning turbojets. Some 50 Mirage IV bombers are slated to form the nuclear strike force being programed by the French military.

From the home of *Planned Pioneering*

THE MODEL 711 **Strainistor**

Ultra Sensitive Strain Sensing Elements
60 to 70 times greater Sensitivity than other metal strain gauges.

FIRST COMMERCIALLY AVAILABLE

- Strain sensitivity 120-140
- 120 Ohm nominal resistance
- Resistance change linear with strain.
- Negligible hysteresis
- Suitable for static and dynamic measurements.
- Combination mounting and handling fixture with each Strainistor.

century
ELECTRONICS & INSTRUMENTS, INC.
The Home of Planned Pioneering
TWX-TU 1407 Phone LUther 4-7111
P. O. Box 6216, Pine Station, Tulsa 10, Oklahoma

Manufacturers of light beam galvanometers and magnetic assemblies since 1945.

Serviced by Systems Engineering Offices of Airsupply-Aero Engineering Division of the Garrett Corporation

- *Offices in All Principal Cities*

INERTIAL SYSTEM TEST

Can you measure a movement several thousand times slower than the hour hand of your watch? With the skills of an expert organization behind you, could you design and develop your own test methods, equipments, and procedures? These would be for the evaluation of servo, gyro, and accelerometer performance and early prototype inertial systems, and would include precision voltage analog measurements. Write to Mr. S. L. Hirsch.

LITTON SYSTEMS, INC. Electronic Equipments Division
Beverly Hills, California

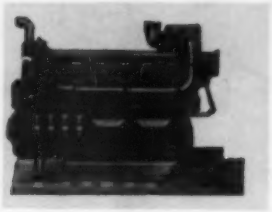
WHO TURBOCHARGED THE DIESEL FOR THE CONSTRUCTION INDUSTRY?

to give you best value first

It's a long way in time and design from the first four cylinder **diesel** engine of 89 HP manufactured by Caterpillar 29 years ago as compared to today's big but compact Turbocharged, Aftercooled V-12 developing 730 certified brake horsepower. But these two engines have one thing in common – they are the result of searching effort to produce the highest quality diesel engine available.

The acceptance of Caterpillar Engines can be seen in every type of application – protected or in the elements, on land and sea. A major shrimp boat manufacturer as an example powers two-thirds of all the vessels he produces with Caterpillar Engines.

Because Caterpillar has constantly strived to improve its products, a good many "firsts" in diesel engine development have benefited every kind of engine user. In addition to being the first to turbocharge and aftercool a diesel for the



engine power

BY CATERPILLAR

construction industry, such advances as capsule-type fuel injection valves that can be replaced as easily as a spark plug for a cost of less than ten dollars reveal Caterpillar's direction: the building of high-performance, economical diesel engines.

Today, Caterpillar is producing compact, lightweight, high-output engines from ultra-modern facilities devoted to research, design and manufacturing. Cat Diesels are available up to 730 HP and electric set ratings of 400 KW. For profitable use in construction, mining, railroad, petroleum, agricultural, marine, logging and hospital standby electric set applications, choose Caterpillar Diesels.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Engine Division, Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

contract basis by Land Air, Inc., located at Cheyenne Airport. Originally, this was meant only for assigned Douglas C-47s and Cessna U-3As and Land Air personnel are not familiar with helicopters, especially new machines such as the Kaman H-43B.

Down-time of the Huskie became a problem so Kaman brought in seven maintenance personnel to beef up the Land Air capability.

Other aircraft involved in the program suffer a similar problem, indicating that the maintenance problem is a local one, rather than being confined to a particular type of equipment.

FAA Adopts Visual Glide Slope System

Washington – Federal Aviation Agency adopted the British RAE visual glide slope system last week as a national standard designed to promote safety and reduce noise at airports.

Selected from five different systems evaluated at FAA's National Aviation Facilities Experimental Center, Atlantic City, N. J. (AW Mar. 28, p. 108) the RAE, or "Red and White," system was developed by the Royal Aircraft Establishment in England and requires no equipment in the aircraft.

NAFEC engineers estimate that a complete RAE system, which FAA will rename VIGS for visual glide slope, can be installed at large airports for about $10,000 at a runway where the airfield is already equipped with an approach light system and for $30,000 at other runways. At smaller airports where the cost of a full system might be prohibitive, FAA said, an RAE system with fewer lights could be installed for as little as $1,500.

Using a combination of red and white lights mounted on either side of the runway in the touchdown area, a full RAE system consists of six 4-ft.-long bars of light on each side of the runway, with one set of three bars 750 ft. from the approach end of the runway and the other at 1,250 ft. Lights are enclosed in boxes and are seen by the pilot through a slit in the box. Red filters change the appearance of the lights depending on the angle of approach, with flights below the proper path angle seeing all red lights and those above, all white. On approaches made on the proper glide slope, the system presents the pilot with a view of the near bars of light as white and the far bars as red.

Use of the system helps avert the danger of collisions with terrain and obstructions in the approach area, reduces the chances of overshooting or undershooting on landing and aids in noise abatement by keeping landing aircraft on a high glide slope angle.

PRODUCTION BRIEFING

Horkey-Moore Associates, division of Houston Fearless Corp., Torrance, Calif., will design and fabricate a systems test fixture for ground checkout of the Ranger spacecraft. The test equipment will be used to check out ground support units for the Ranger moon exploration vehicle.

Pacific Airmotive Corp. has opened an Eastern sales office at Westchester County Airport, White Plains, N. Y. The new office represents an effort to increase overhaul and modification sales of Pacific Airmotive and its subsidiary, PacAreo, in the eastern United States.

All American Engineering Co., Wilmington, Del., will produce 1,238 spring steel emergency arresting hooks for North American F-100 aircraft. The initial contract amounts to $256,000; however, the total award is expected to exceed $600,000.

ACF Electronics Division, Riverdale, Md., will build an additional flight simulator of the Republic F-105D under $1,002,800 contract from AMC's Aeronautical Systems Center. The award brings to five the total number of F-105D flight simulators ordered.

WHITNEY-JENSEN
MARSHALLTOWN
CAM PRESSES

FOR ASSEMBLING
FOR STAKING
FOR PUNCHING
FOR FORMING
FOR SIZING
FOR RIVETING

No. 101
MULTIPURPOSE PRESS

CAPACITY
THREE THOUSAND POUNDS

DIE SPACE

No. 102
ADJUSTO-GAP CAM PRESS

No. 101 4¼"
No. 102 1" to 14"

Write Us Now
For Complete Information and Prices
WHITNEY METAL TOOL CO.
734 Forbes St., Rockford, Ill.

THAT'S OUR "CUP-OF-TEA" AT STONER! We take the tough jobs other companies won't do or can't do! Our team of Rubber Chemists and Production Engineers like the challenge of helping you solve your problems. Maybe you have a close tolerance job; barrier problem; bonding problem, etc. We invite your blueprints for quotation or recommendation.

Write for our new 24 page illustrated catalog

STONER RUBBER COMPANY, INC.
10792 Knott Ave., Anaheim, California
A subsidiary of CARLISLE CORPORATION

REPRESENTATIVES
PHOENIX Howe & Howe 4328 North 42nd Place
DALLAS L. M. Harris P.O. Box 5936 Terminal Annex Bldg.
SEATTLE J. S. Barlow Northwest Plastics 1220 East Cherry

Shifting Aims Delay First T.188 Flight

By Cecil Brownlow

London—Shift in direction of Britain's major development goals is delaying the first flight of Bristol Aircraft, Ltd.'s, T.188 all-steel research aircraft by approximately six months—from early autumn to present unofficial projection of sometime next spring.

Spokesmen connected with the project said the British government's decision to limit its goals for high-speed military aircraft performance plus plans to restrict initial supersonic transport designs to a Mach 2.3 regime have combined to lessen the drive for first flight of the T.188, which is eventually scheduled to probe beyond Mach 3. As one spokesman said, "now there's just no hurry for the thing."

The T.188, laid down approximately six years ago as a vehicle to pave the way for future military designs, will now be used primarily as a pure research vehicle to expand Britain's state of the art at high-speed regimes. Present research missions include experimentation with various engine and intake configurations plus studies of kinetic heating, structural stresses and high-speed shock wave formations.

One T.188 fuselage has been delivered to the Royal Aircraft Establishment at Farnborough for strain gage tests. Test flights will be conducted from the Aeroplane and Armament Experimental Establishment at Boscombe Down with Godfrey Auty, Bristol's new chief test pilot, at the controls.

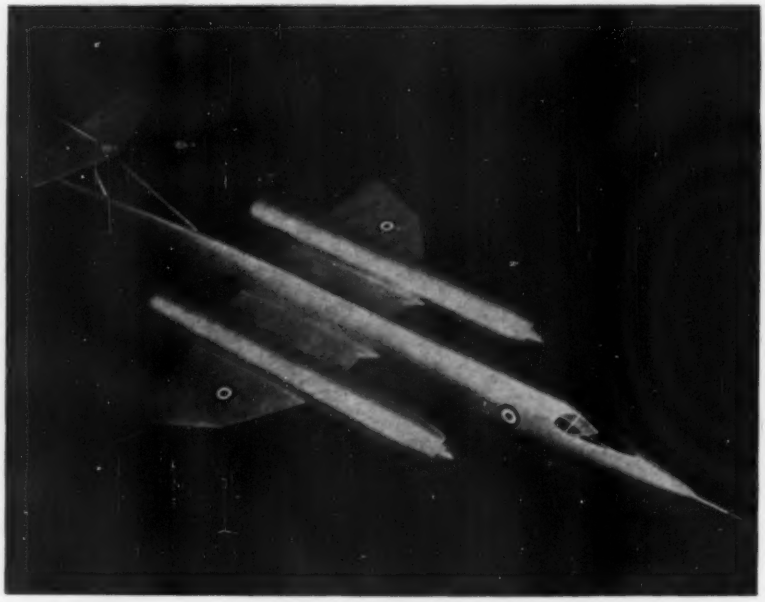
Initial limits of the T.188, powered by two de Havilland Gyron Junior DGJ.10 turbojets producing 14,000 lb. thrust each with afterburner, is expected to be between Mach 2.3 and 2.5, ranges already amply explored.

Will Exceed Mach 3

After the aircraft has proved itself in its initial design speeds, the range is scheduled to be pushed beyond Mach 3 in progressive steps by the adaption of ramjets and ram-turbojet powerplants (AW Dec. 21, p. 22).

The decision to house the powerplants in long wing nacelles rather than burying them in the fuselage or wing was largely determined by the original Ministry of Supply requirement stipulating that the aircraft be capable of accepting various engine installations in order to broaden its research capabilities.

According to Bristol officials, however, choice of stainless steel for the airframe, which will permit Mach 3 flight, was a fortunate coincidence, made initially with little thought of such speeds.



ALL-STEEL fuselage and wing section of Bristol Type T.188 (top) nears completion at Bristol's Filton works. Workman gives indication of engine nacelle diameter. First T.188 is scheduled to begin its test flight program by early next year. Model (below) shows general configuration of all-steel Type 188 high-speed research aircraft under development for British government, including long engine nacelles designed to take a number of engine configurations. Fuselage length is 71 ft.; wing span, 35 ft. 1 in. Powered by two de Havilland Junior DGJ.10 turbojets, T.188 will have an initial maximum speed of between Mach 2.3 and 2.5. However, with more powerful engines, probably including ramjets, the aircraft may be pushed beyond Mach 3.

The Ministry of Supply requirement demanded that the aircraft be capable of sustained speeds in excess of 1,500 mph. British knowledge of titanium alloys at the time was thin, and stainless steel was decided upon as the only metal capable of coping with the temperatures involved.

T.188's thin wing, which has a span of 35 ft. 1 in. and an area of 396 sq. ft., has a constant chord between the fuselage and the protruding engine

nacelles. Outboard of the nacelles, however, the leading edge is swept back at an angle of 38 deg., and the tip of the wing, formed by the balance area of the aileron forward of its hinge, has a leading edge sweep-back angle of 64 deg.

Swept-Back Fin

Oval-shaped fuselage has an over-all length of 71 ft., a maximum width of 3 ft. 9 in. and a maximum depth of 4 ft. 11¼ in. In order to clear the engine exhaust, the slab tailplane is mounted on top of a swept-back fin.

Another Ministry of Supply requirement stipulated that the aircraft should have a conventional tricycle landing gear as opposed to the skid designs of recent high-speed U. S. research aircraft.

The landing gear is being constructed by British Messier, the tires, which must withstand temperatures of over 400F, by Goodyear Tyre & Rubber Co., Ltd.

Instrumentation to measure and record aircraft behaviour and flight conditions will be housed in the fuselage. Some information will be recorded and stored in the aircraft for examination after landing, and some will be telemetered to the ground during flight.

By weight, more than 90% of the materials used in the construction of the T.188 were fabricated by Firth-Vickers Stainless Steels, Ltd., of Sheffield. Joint research efforts by Firth-Vickers and Bristol also led to the development of two new steels for possible use on future high-speed aircraft. Their development, however, came too late for incorporation into the T.188.

Stainless steel plates for the aircraft's skin were supplied in relatively large sections in order to avoid an excessive number of joints. Rolled bars were used for bolts, fasteners and other fittings.

Special forgings, believed by Firth-Vickers to be the largest steel forgings for aircraft ever made, were developed for the engine nacelles. High tensile forgings were used for the wing attachments.

Keel boom of the aircraft is formed by a single 27-ft.-long steel forging. Stainless steel piping also is used on the T.188 for the hydraulic system which powers the landing gear, flaps and controls.

RAF's Sprung Seat Platform System May Isolate Pilots From Vibration

Investigations at the Royal Air Force Institute of Aviation Medicine of the effects of vibration on pilots have led to the development of a simple and compact seat suspension platform which is completely isolated from external excitation. The sprung seat platform, which was developed at the Royal Aircraft Establishment, Farnborough, is thought to be the first sprung system that provides a stable point of zero stiffness for a supported mass at a particular datum position in all six rigid body degrees of freedom simultaneously.

No application of the system has so far been revealed but it appears that the RAE seat is destined for the TSR-2 supersonic strike aircraft. It is also believed to have been used as the instrument mounting platform somewhere in Britain's missile arsenal.

Frequency response investigations undertaken by RAF medical researchers on themselves on a specially constructed shake rig showed that a band of very low excitation frequencies suffice to resonate different parts of the body, which develop hefty relative displacements in spite of the body's high inherent damping characteristics. An example occurs at about five cycles per second when the body displacement is highly attenuated but the shoulders resonate with an amplitude of the order of two inches. At slightly higher frequencies the head develops maximum amplitudes. The hips resonate at slightly lower frequencies.

It is this low frequency, high amplitude band of excitation frequencies which pilots experience during low level, high speed flight, due to air turbulence. The same band of excitation frequencies forms a significant part of the vibration spectrum affecting missile instrumentation.

System Fundamentals

Principle of the system depends on the fact that if the excitation frequency is considerably in excess of the natural frequency, the amplitude of the displacement is greatly attenuated. Reducing the stiffness of a sprung system lowers its natural frequency and in the limiting condition of zero stiffness, the natural frequency also becomes zero and hence immunizes the system from external excitation.

Absolute zero stiffness cannot be utilized in any practical application because it implies that in the event of any displacement there is no restoring force. This condition can be bypassed for most applications by providing a non-linear stiffness characteristic that provides a near zero stiffness for small displacements with a rapidly increasing stiffness as the displacement increases. Providing the range of low stiffness exceeds the amplitude level of troublesome vibrations, effective vibration isolation is achieved for both linear and rotational motions.

One system developed by W. G. Molyneux at the RAE employs three sets of helical springs. The loading platform is located between two sets of vertical springs, one set being in tension and the other in compression, and by a set of horizontal toggle springs. All sets of springs are preloaded in the datum position.

The analysis shows that by assigning values to the stiffnesses of each system of springs, and to the initial deflections of each system in the datum position, the stiffness of the over-all system—obtained by differentiating the expression for displacement—has a minimum value of any desired amount, at the datum position, and a high stiffness against large displacements.

Different arrangements of the springs can be made which provide for applications where isolation from linear vibrations only is required and where stiffness for rotational motions is high. These requirements are typical of gyroscope mountings in missiles and aircraft.

Underwater Ejection Tests

High speed ram effects at ejection speeds up to 515 kt., simulated for the first time under water in a centrifuge rig with a live subject, have shown that existing seat body restraints are inadequate. Measurements made by RAF medical researchers at the Admiralty Research Establishment, Teddington, have revealed force vectors of 570 lb. tending to lift and open the thighs and a 170 lb. vector operating on the arms. These forces considerably exceed estimated values.

Tests carried out by the doctors on themselves during high speed runs have also clarified the injury mechanisms experienced. Eye reddening is not, as previously believed, caused by displacement of the eyeballs in their sockets but is simply due to differential blood pressure effects. Ram pressure of 7¼ psi. acting on the larger area of the chest causes the chest to pump blood into the head which raises the pressure and ruptures the weaker blood vessels.

The maximum underwater speed achieved on the Admiralty underwater whirling arm at Teddington was 20 kt., equivalent to a speed of 515 kt. sea level. Total body pressure experienced at this speed was 3,700 lb.

Cavitation on the underwater seat caused extensive body bruising on the doctors experimenting in this program.

The RAF Institute of Aviation Medicine is conducting a number of investigations having space applications.

Classified high speed, high altitude research at the Farnborough establishment includes work on a three-seat, side-

USAC TRANSPORT INC

READY TO DO IT TODAY

EQUIPPED TO HANDLE HEAVY OR BULKY SHIPMENTS

U.S.A.C. EXPERTS MOVE CARGOES QUICKLY AND SAFELY

Offices:
Mobile, Alabama
Montebello, California
Sacramento, California
Englewood, Colorado
Smyrna, Delaware
Miami, Florida
Warner Robins, Georgia
Indianapolis, Indiana
Middletown, Pennsylvania
Dallas, Texas
Clearfield, Utah
Norfolk, Virginia

457 WEST FORT ST.
DETROIT 26, MICH.
TWX DE899 WO 3-7913

by-side, cabin arrangement for an unspecified aircraft, which could have space cabin potential. The entire cockpit mockup is currently on the large centrifuge at Farnborough.

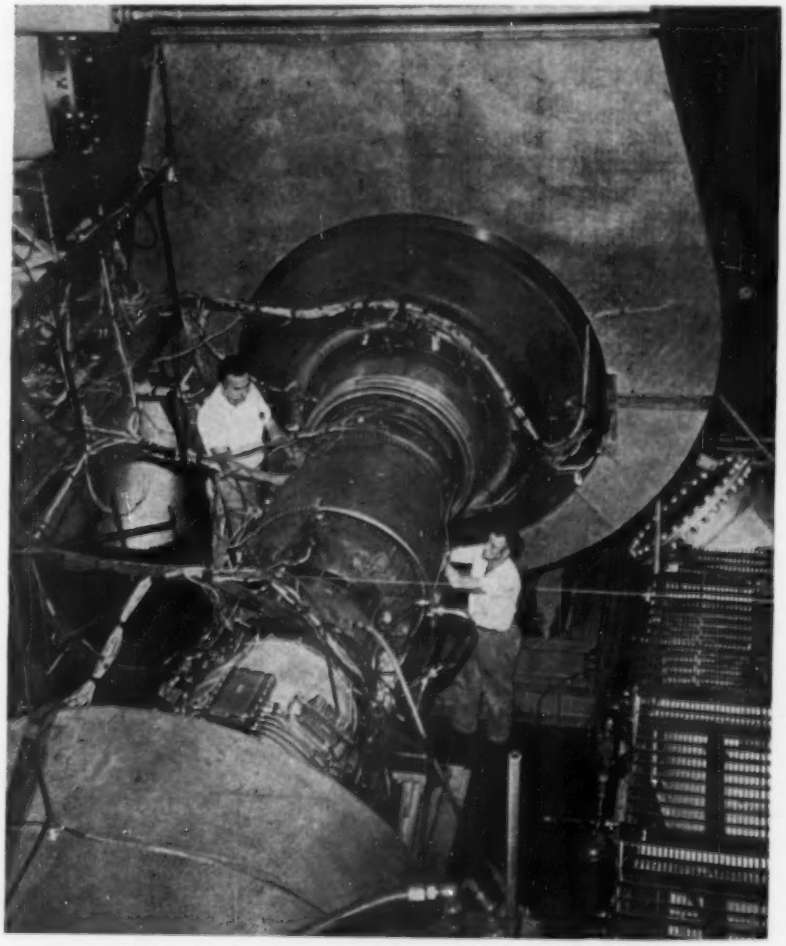
Classified investigations believed to concern very high altitude effects, using the nose section of the Victor bomber, also are being conducted.

The Institute has devised a number of techniques to simulate or establish zero g conditions. Experiments have been carried out with lift shafts and underwater, mainly to investigate hand-eye coordination in the weightless condition. The principal technique developed differs from that used for similar experiments in the U.S., an official told AVIATION WEEK, in that the subject does not view a target object directly, but through an optically projected image of the same size. This "opens" the human control loop and prevents the subject from monitoring the movement of the hand toward the object.

A novel method of determining peripheral vascular resistance in the weightless condition has also been developed, in which the subject was placed in the Farnborough centrifuge aligned longitudinally with the centripetal acceleration, first with his head outward for a series of positive g loadings up to 4g, and then with his head inward for a similar series of negative g loadings.

The effects of zero g which cannot be simulated in the centrifuge were found by extrapolation to lie roughly on a straight line passing through the positive and negative values.

A new method is also claimed by medical researchers at Farnborough to measure cardiac output changes under positive g loading on the centrifuge. Access to the heart was gained by a catheter inserted through a vein in the arm and passing into the right ventricle. Cardiac output was derived from the change in oxygen content of the blood sampled from the catheter.



J57 Tested as Stationary Power Unit

Stationary power unit, using Pratt & Whitney J57 turbojet engine, is readied for a test run at P&W's Willgoos test facility at East Hartford, Conn. Engine supplies power to a turbine developed by Cooper-Bessemer Corp., Mt. Vernon, Ohio; unit will burn natural gas as it pushes gas through transmission lines of Columbia Gulf Transmission Co.

PEA IN A POD IN SPACE is the Bendix Free Reaction Sphere for precision attitude control of satellites and space vehicles. It is an example of technique leadership and career opportunities in advanced systems such as the Eagle missile, Advent satellite communications, and Skyscraper infrared system.

BENDIX SYSTEMS DIVISION
ANN ARBOR, MICHIGAN

BELL CLAIMS 7 NEW WORLD RECORDS

Here are the Records Claimed for Faster Climb and Air Speed by Bell-Built Army HU-1 "IROQUOIS"

THE SEVEN NEW RECORDS*

1. **Climb to 3,000 meters (9,843 feet):**
   Current record: 5:30.6 minutes—held by French Alouette
   HU-1 record claim: 3:22.4 minutes

2. **Climb to 6,000 meters (19,686 feet):**
   Current record: 11:0.1 minutes—held by French Alouette
   HU-1 record claim: 8:10.2 minutes

3. **Non-stop Distance, Closed Circuit:**
   Current record: 345.1 miles—held by Russian MIL-1
   HU-1 record claim: 441.74 miles

4. **Speed Run, 3 kilometers (1.864 miles):**
   Current record: none
   HU-1 record claim: 158.05 mph

5. **Speed Run, 100 kilometers (62.14 miles):**
   Current record: 130.8 mph—held by Russian MIL-1
   HU-1 record claim: 142.2 mph

6. **Speed Run, 500 kilometers (310.69 miles):**
   Current record: 136.02 mph—held by Sikorsky
   HU-1 record claim: 148.45 mph

7. **Speed Run, 500 kilometers (310.69 miles):**
   Current record: 122.07 mph—held by Russian MIL-1
   HU-1 record claim: 148.45 mph

*Tests were run during eight grueling days in July, 1960 under the supervision of the National Aeronautical Association. Certification is pending from N.A.A. and Federation Aeronautique Internationale.

BELL HELICOPTERS — WORLD STANDARD

Many of these performance advantages are passed on to you in Bell's Model 204B, a commercial version of the HU-1. However, speed and climb records are not *all* the story of Bell's 204B. It has a pay load of nearly two tons and is lower in initial cost, easier to service and cheaper to maintain and operate than any other helicopter in its class. Thus in claiming new records, Bell also maintains its *economy and service* record established years ago and still continued today.

Write for full information on the new Bell 204B . . a helicopter designed to fly your toughest missions in the shortest time . . at the lowest cost.

For operational first in turbine-power, look to

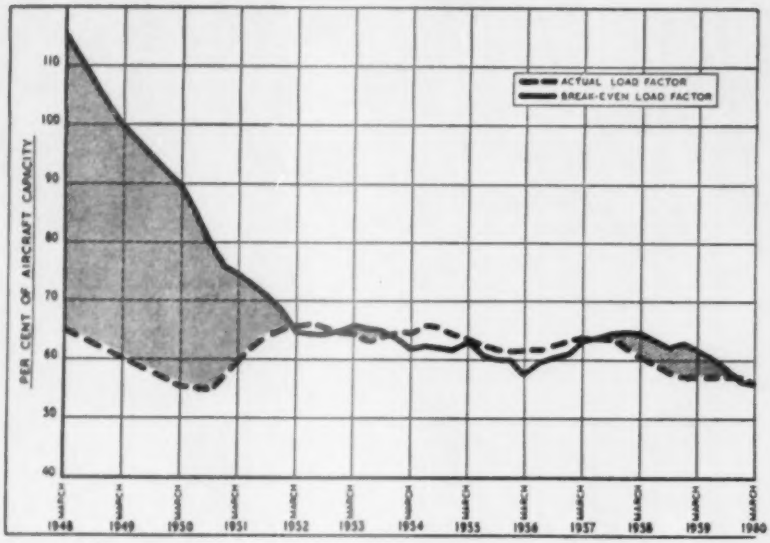
BELL HELICOPTER COMPANY *Fort Worth, Texas*
Division of Bell Aerospace Corporation

BOAC Deficit Rises; BEA Reports Profit

British Overseas Airways Corp. reported improved operating results in its 1959-60 fiscal year, but its over-all net loss continued a trend that has increased its accumulated deficit from $8.5 million to $42.6 million in three years.

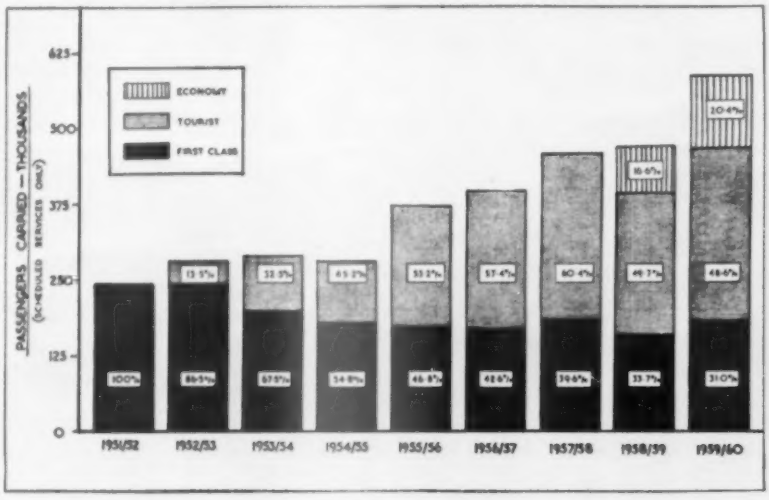
This is in contrast to British European Airways, which reported a $5.8 million profit in the same fiscal year, and the Commonwealth carriers, Qantas, which reported a $2.4 million profit for the year 1959 and Trans-Canada Air Lines, a $152,554 net profit.

Comparisons with other Commonwealth airlines, or with U.S. international airlines, are hard to draw because of differences in accounting practices and terminology and because of the nebulous function of British Overseas Airways Corp. as an instrument of national policy, either economic or diplomatic.



BRITISH OVERSEAS AIRWAYS charts show (top) trend in actual and breakeven load factors since 1948 and changes in classes of service (below).

RELATIVE GROWTH OF TOURIST AND ECONOMY TRAFFIC



Problem Areas

But some insight can be gained into the special problem areas of BOAC by comparing summation of its 1959-60 profit and loss statement with BEA's:

BOAC		BEA
	Operating Profit	
$12,041,604		8,864,382
	Interest on government-owned shares or exchequer grants	
$16,252,163		$5,086,354
	Interest capitalized	
$2,983,292		.....
	Interest receivable	
$2,015,143		1,857,937
	Subsidiary companies profits or (losses) and related adjustments	
($3,112,502)		267,699
	Profit (deficit) for year	
($2,334,626)		$5,841,018

BEA, after adjustments, and appropriating $1.4 million to its insurance reserve, and $2.8 million to a development reserve, was able to carry a net balance of $225,492 to this year. After favorable adjustments from prior years, BOAC carried a $1,588,625 net loss to its accumulated deficit, to total $42,665,893.

The reason why BEA can lay aside funds for reserves and show a small net profit while BOAC continues to accumulate deficits appear to lie from this comparison in the heavy debt structure of BOAC and its losses on subsidiary and associated company operations.

BOAC subsidiaries resent the parent singling out company's for their losses. Middle East Airlines, for example, provides BOAC with feeder traffic worth $4.2 million annually and points out it has bought $15 million worth of British aircraft and has $17 million in Comet 4C orders.

BOAC's total borrowings are almost three times those of BEA. They break down into:

- **BOAC stock** amounting to $160 million and bearing interest rates of 2½ to 4½%. BEA'S comparable stock amounts to $44 million at 3 and 4½% interest.
- **Exchequer advances** which total $200 million and carry interest rates from 4⅛% to 5¼%. BEA's advances from the minister of aviation total $90 million.
- **Bank loans** including a U.S. dollar loan, of $21 million. BEA does not carry its short term bank credit as part of its capitalization, but shows $1,300,000 in bank credit in its current liabilities. For BOAC, this is a total capital investment of $381 million, compared with $134 million for BEA. Flight equipment and property, including 99

CONTROL TOWER IN A

SPECIAL DELIVERY PACKAGE

Portable air traffic control towers—to be produced by Hamilton Standard—can be flown or trucked to speed mobilization of remote TAC air fields

The Air Force has selected Hamilton Standard to produce 150 air traffic control vans, plus 53 trailer-mounted electronic shops for servicing the control vans and other types of electronic equipment in the field. The van will be used, as shown here, by the Tactical Air Command to direct air traffic at remote or temporary landing fields.

LIGHTWEIGHT, RUGGED, EASY-TO-OPERATE—Each van weighs about a ton, measures 5′ x 5′, yet houses an operator, transmitters, receivers, and most of the basic weather equipment of large airport control towers. The units are built to withstand the most grueling environmental conditions—sand, wind, dust, ice, humidity, altitude. Every construction element—equipment, lighting, sound conditioning—is engineered to blend man and equipment into an efficient operating unit.

OTHER GROUND SUPPORT EQUIPMENT IN PRODUCTION at Hamilton Standard includes liquid cooling carts for an advanced airborne missile system, cooling packages for a missile silo application, and electrical simulators for military cargo aircraft.

SOLID FOUNDATION FOR YOUR GSE—Hamilton Standard has the ability to supply the widest range of aircraft and missile ground support equipment—from tiny precision components to complete architectural structures and weapon subsystems. This ability stems from over 40 years' experience in systems-engineering its own laboratories and broadening product lines. To learn how this vast engineering resource and Hamilton Standard's world-wide service organization can serve you, phone or write: Hamilton Standard Ground Support Equipment Department.

HAMILTON STANDARD

DIVISION OF UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT

SOME OF THE MANY FIELDS OF GROWTH AT HAMILTON STANDARD

ENVIRONMENTAL CONDITIONING SYSTEMS for space vehicles and such advanced aircraft as the B-58, 880, B-70 are important aspects of Hamilton Standard diversification.

ENGINE CONTROLS for over 20,000 aircraft gas turbines have been produced by Hamilton Standard. The company's latest control work involves advanced rocket engines.

ELECTRONICS at Hamilton Standard includes broad experience in flight control, instrumentation, static power inversion and electrical control for aircraft, missile and GSE components.

FOR HIGHER RELIABILITY IN THE HIGH TEMPERATURE RANGE

MIDVAC STEELS MEET THE MOST CRITICAL DESIGN APPLICATIONS

Where parts for missiles, rockets, aircraft and other jet age products call for super alloys of maximum reliability at temperatures of 1000°F. and over, Midvac Steels offer designers new opportunities of applications.

Midvac Steels, produced by the consumable electrode vacuum arc melting process have these advantages over conventionally produced steels:

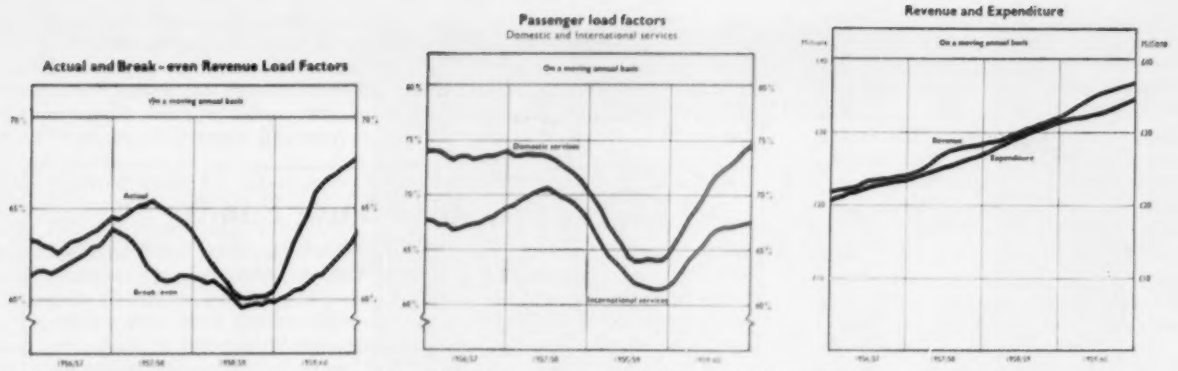
1. Improved ingot soundness.
2. Reduced ingot segregation.
3. Improved chemical homogeneity.
4. Refined cast structures—less forging reduction necessary.
5. Improved cleanliness.
6. Gas content reduced to a minimum.
7. Improved workability.
8. Improvement in room temperature properties—fatigue, impact, transverse ductility, etc.
9. Improvement in elevated temperature properties—hot fatigue and stress rupture.
10. Consistent higher quality product—less customer rejections.

Midvac Steels are offered in many alloys as billets or forgings to meet the most critical design specifications. Complete details on Midvac Steels, plus comparative analysis of leading super alloys are available in new Midvac Steel Booklet. Write for your copy to . . .

MIDVALE-HEPPENSTALL COMPANY
Nicetown, Philadelphia 40, Pa.
Subsidiary of Heppenstall Company, Pittsburgh, Pa.

Midvac Steels

MH


Actual and Break-even Revenue Load Factors
Passenger load factors
Domestic and International services
Revenue and Expenditure

BRITISH EUROPEAN AIRWAYS charts depict load factor trends and improving spread between revenues and expenses.

aircraft with a book depreciated value of $59 million and progress payments for aircraft under construction of $40 million are the major source of employment of BEA's capital.

Fleet Costs

BOAC's statement of capital employed includes $176 million book depreciated value for its fleet of 62 aircraft, $65 million for progress payments and $34 million in investments in associated and subsidiary companies as major items. Dividing total undepreciated fleet costs by the number of aircraft:

- **BOAC average aircraft cost** figures at $3.5 million for its fleet of predominately larger, longer range aircraft –Bristol Britannia 102 and 312s, de Havilland Comets 4s and Douglas DC-7s.
- **BEA average aircraft cost** of $872,000 for its predominately Vickers Viscount fleet.

Even this is not an exact comparison of fleet costs since BOAC wrote off $14 million in Comet and Britannia development costs in its 1958-59 fiscal year against its capital account, indicating this figure is not reflected in its balance sheet book value figure for its total fleet cost.

BOAC had not begun to take delivery of its 15 Boeing 707-420s which will add at least $70 million to BOAC's fleet value this year and this cost is not reflected in the accounts. BOAC also has 35 Vickers VC.10s on order under contracts totaling $150 million, due for delivery starting in 1963.

New Aircraft

BEA also has large commitments for new aircraft–$102 million for 24 British Aircraft Corp. DH-121s and $47 million for 20 Vickers Vanguards, due in service later this year after a delay due to engine modifications.

Borrowing powers of both corporations were raised this year, BEA's limit to $266 million and BOAC's to $504 million. BOAC, which paid annual interest charges of $16 million last year compared with $5 million for BEA, with a substantial accumulated deficit and with a fleet proportionately less depreciated than BEA took a significantly different tack than BEA had taken in the tone of its commentary on the annual figures.

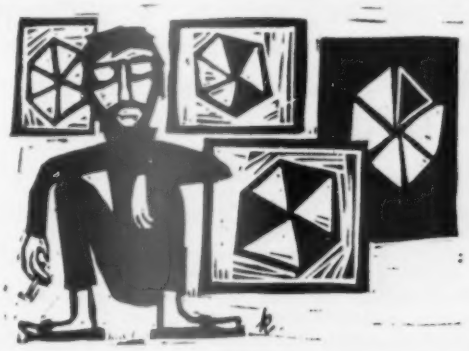
BEA seemed faintly apologetic at its net profit and reiterated its awareness of its social obligations as a national corporation to bring air transport to the people at lower cost.

BOAC on the other hand said little about social obligations and took care to point out that in the eight years since its formative period it has had to pay fixed interest charges of $41.4 million to the government. To do so, it had to borrow an additional $38.3 million from the same source on which it has had to pay still further interest charges.

Because of the delay in delivery of the 707s for modifications to the tail, BOAC said it had to borrow only $11 million during the year. But substantial increases will be needed now–$58.8 million in the next three years and an additional $56 million in 1963-64 when VC.10 deliveries begin. Redemptions and retirements should offset increase in total debt, but it is plain that BOAC will be approaching its statutory limits though it feels the new ceiling will be adequate for its needs.

BOAC did note that it was gratified

PROBLEMATICAL RECREATIONS 35



Each face of a regular dodecahedron is painted with a different color. Using the same 12 colors, how many dodecahedrons with different color arrangements are possible? –*Mathematics Magazine*

To the National Electronics Conference in Chicago, and to the distinguished sponsors, we wish a colorful meeting.

LAST WEEK'S PROBLEM: The mother was 6 when her child was born, which makes the banana 534 inches long 12 years later.

LITTON INDUSTRIES
Beverly Hills, California

that the Select Committee on Nationalized Industries pointed out that too much of the cost of developing new British aircraft appeared to fall on BOAC and BEA, placing them at a disadvantage with competitors using American aircraft. Various measures to provide additional support to the manufacturers at the same time will be partly defeated if the manufacturers are required to include in the price charged for their aircraft a levy to reimburse the government, BOAC added in a cautionary sentence.

A specific concern expressed by BOAC was on the status of its 10 DC-7Cs, ordered as an interim measure until its long-range Britannia 312s became available, on agreement that they would then be re-exported. These aircraft are carried at a book value of $16.5 million or $1.6 million per aircraft.

Sale of these aircraft on the open market now might be a sacrificial one, BOAC said, and no provision has been made in the accounts to absorb such a loss. Some, or all, of this loss might be avoided if BOAC was permitted to continue to use the airplanes, especially on long range contract operations.

BOAC apparently tends to follow a less pessimistic depreciation policy than other International Air Transport Assn. carriers. An informal survey made by a U.S. carrier showed most IATA carriers favored a 10-year, 10% residual value schedule for jet aircraft. BOAC spoke in terms of a seven-year, 25% residual value schedule. For a $4 million airplane, this would mean higher annual depreciation charges, but a smaller total charge at the end of the depreciation period.

Comet Write-Off

Actual practice may vary from these professions, however. BEA, for example, is depreciating its five Comet 4B aircraft at the rate of one-eighth of cost per year, though BEA did not indicate whether these would in fact be written down to zero residual value.

In a capsule summation of its basic competitive objectives, BOAC said that it is pursuing an expansionist policy that has increased its capacity ton miles from 261,004,581 in 1956-57 with a corresponding average load factor of 63.1 to 438,182,504 in 1959-60 with an average load factor of 57.6. The risks of this policy to the profit and loss account must be justified by the long term prospects, BOAC said.

One area BOAC is stressing is carrying out this objective in the reduction of maintenance costs as a contribution to cutting break even load factor—which stood at 55% this year, compared with 63% three years previously. BOAC reduced its maintenance personnel by 1,251 during the year, cutting its maintenance department costs 1.6 cents a capacity ton mile, the report said.

BOAC's total personnel rose slightly, however.

BOAC's maintenance costs are 24% of its 1959-60 expenses totaling $184 million, or 23% of its $196 million revenues. BEA spent on maintenance 18% of its 1959-60 expenses of $93 million or 16% of its revenues of $102 million. Though accounting methods may not permit a valid comparison, Pan American spent 15% of its 1959

Fiscal 1960 Defense Funds

Aerospace procurement and research obligation and expenditure details for Fiscal 1960 have been released by Department of Defense. Obligations are indicative of new contracting; expenditures, of the actual level of production or research effort sustained throughout the year. Comparisons with previous fiscal years are impractical because of changes in budget categories—notably the shift of funds, previously listed under "procurement," to the development, test, and evaluation category.

Procurement

	Obligations (Thousands of Dollars)		Expenditures (Thousands of Dollars)	
	FY 1960	Unobligated Balance, June 30, 1960	FY 1960	Unpaid Obligations, June 30, 1960
Army				
Aircraft	152,953	.....	127,006	179,973
Missiles	646,134	111,451	707,735	829,093
Electronics and Communications	210,972	.....	264,035	271,140
Navy				
Aircraft	1,899,704	1,225,199	1,796,225	2,178,828
Missiles	660,308	188,347	349,395	847,290
Electronics and Communications	215,944	105,069	179,564	307,210
Air Force				
Aircraft	3,594,645	1,673,229	4,792,034	4,031,745
Missiles	2,629,012	487,471	2,753,458	2,136,074
Electronics and Communications	792,011	351,296	759,753	877,207
Department of Defense Total				
Aircraft	5,647,302	2,898,428	6,715,265	6,390,546
Missiles	3,935,454	787,269	3,810,588	3,812,457
Electronics and Communications	1,218,927	456,365	1,203,352	1,455,557

Research, Development, Test and Evaluation

	Obligations (Thousands of Dollars)		Expenditures (Thousands of Dollars)	
	FY 1960	Unobligated Balance, June 30, 1960	FY 1960	Unpaid Obligations, June 30, 1960
Army				
Military Sciences	144,853	23,133	121,379	99,943
Aircraft	21,032	18,405	13,280	24,426
Missiles	489,300	42,962	273,926	301,904
Navy				
Military Sciences	119,150	5,562	103,062	89,124
Aircraft	88,518	13,217	95,116	71,138
Missiles	460,799	13,416	274,030	248,814
Astronautics	.....	5,500	.....	.....
Air Force				
Military Sciences	165,152	25,140	107,237	137,754
Aircraft	173,232	38,878	115,755	127,454
Missiles	176,184	12,634	144,631	101,252
Astronautics	301,237	9,791	179,968	121,269
Office, Secretary of Defense				
Military Sciences	36,400	7,266	13,400	34,931
Missiles	90,750	27,753	50,115	70,099
Astronautics	181,500	25,843	253,145	69,610
Department of Defense, Total				
Military Sciences	465,555	61,101	345,078	361,752
Aircraft	282,782	70,500	224,151	223,018
Missiles	1,217,033	96,765	742,702	722,069
Astronautics	482,737	41,134	433,113	190,879

total expenses of $339 million on maintenance and TCA 28% of its $120 million (Canadian dollars) expenses.

Besides its heavy interest charges, BOAC has one other major area of contrast with BEA in its subsidiary and associated company operations. The results in 1959-60:

- **BOAC share of losses** for subsidiary companies: British West Indian Airways, $1,720,000; Hong Kong Airways, representing accrued loss on sale of the company during the year to Cathay Pacific Airways, $375,000; Mideast Aircraft Co., $105,000.
- **Losses on associated** companies: Bahamas Airways and Borneo Airways, $69,000.
- **Losses on Kuwait Airways** operations contractually undertaken, $670,000.
- **Profits on subsidiaries:** Aden Airways, $160,000; Gulf Aviation Co., $66,000.
- **Profits share** of associated companies: Arab Airways (in liquidation), Ghana Airways, Malayan Airways and Middle East Airlines, $104,000. (The $48,000 net profit of Middle East Airlines was a notable improvement over the prior year when this carrier lost $4.8 million.)

After adjustments, the deficit for the year on subsidiary operations reported by BOAC totaled $3.3 million.

BEA does not have as great an interest in its subsidiary and associated companies, but it reported receipt of $20,000 in dividends from its various profit-making investments including Air Terminals, Ltd., which operates terminals in London; Aer Lingus of Ireland, Alitalia of Italy, Cambrian Airways, Ltd., Cyprus Airways and Malta Airways.

Caravelle Paces French Exports

Paris—Stepped up deliveries of Sud Aviation's Caravelle jet transport during the first half of 1960 have swelled the industry's six-month export figure to $161 million, more than twice the export value delivered in any previous full year.

French industry, in fact, claims that its current export performance, if export figures are related to number of aircraft industry employes, is higher than either the U.S. or Great Britain.

French aircraft exports, about half of which are accounted for by Caravelle sales, are expected to reach $200 million by year-end. Here again, the high export rate mainly will be due to continued Caravelle deliveries.

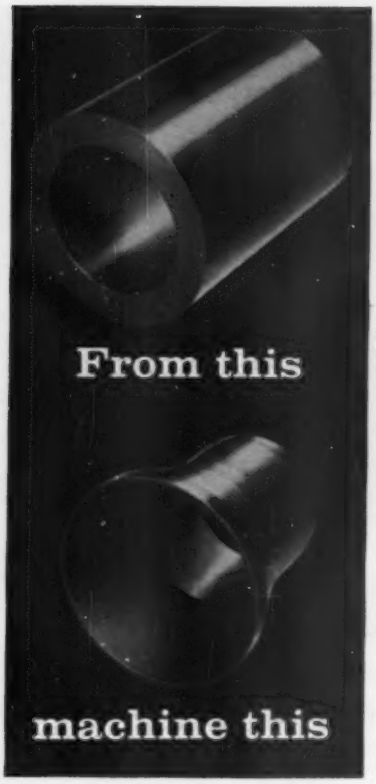
In addition to the Caravelle, the next largest item on the industry's export list is made up by missiles. Some $25 million worth of missiles, mostly Nord Aviation SS-10 and SS-11 anti-tank weapons, were delivered during the first half of this year.

CHARLES E. McGINNIS, B.E.E., M.S.E.E., CHIEF COMMUNICATIONS ENGINEER

"Why did I move to Martin-Orlando? Opportunity for professional growth...doing as big a job as I could handle. More money and better position, too. **Any company that's growing as fast as Martin presents many opportunities. You don't outrun the company. You grow with it. If you have a worthwhile idea that will benefit the company, and you can demonstrate that it will, you get everything you need to put that idea into action. Martin isn't ponderous ...it lets you move fast and get things done. I head up a group of people responsible for getting Martin further into the field of communications, both related and non-related to missiles. We're working on tropospheric scatter systems, random access discreet address communication systems, air traffic control communications, very long range communications systems, applied research on speech bandwidth compression systems . . . things like that. My wife and I really like living in Florida. Never housebound in winter, no snow suit to put on my little girl every time she goes out. A great place to raise a family. The school system is good too."** Write: C. H. Lang, Director of Employment, The Martin Company, Orlando 7, Florida. FOR CAREER OPPORTUNITIES, SEE PAGES 121 AND 127

WORK IN THE CLIMATE OF ACHIEVEMENT

MARTIN ORLANDO



R/M molded rods and tubes for missile research

Take advantage of famous R/M Style 150RPD molding compound in tubes and rods already molded for your developmental work.

You save the cost of dies and molding by machining prototype parts from rods and tubes supplied by R/M in sizes from 1⅛ to 15 in. OD by 15 in. long; or 21 in. OD by 4 in. long.

High-temperature parts made from this molding compound exhibit controlled ablation, good structural strength, excellent thermal-insulating properties, and low thermal diffusivity. Extra-long spinning-grade asbestos fiber provides unusual physical stamina and contributes to high strength-to-weight ratio.

When you have developed and tested your prototype parts, you or your fabricator can then get the desired R/M molding compound in production quantities. Write or call for further information.

RM

RAYBESTOS-MANHATTAN, INC.
Reinforced Plastics Department, Manheim, Pa.
SPECIALISTS IN ASBESTOS, RUBBER, ENGINEERED PLASTICS, SINTERED METAL

Okanagan, Bristol Merger Collapses

Vancouver—Proposed $4 million merger of Okanagan Helicopters, Ltd., and Bristol Aeroplane has been canceled and Bristol President R. J. Reynolds has resigned. His resignation was attributed to "differences of opinion" between himself and Bristol's board of directors. W. S. Haggett, formerly a vice president of Bristol, succeeded Reynolds as president of Bristol.

Under terms of the proposed merger (AW June 20, p. 173), Bristol was to acquire all outstanding shares of Okanagan at $4.50 per share and to enlarge the company by the inclusion of Spartan Air Services of Winnipeg and Autair Helicopters of Montreal. It is understood that Bristol was unable to finance the deal.

New Offerings

Kollmorgen Corp., Northampton, Mass.; principal products include submarine periscopes and other optical equipment, torque motors and other electro-mechanical equipment, and electronic apparatus. Offering is 80,330 shares of common stock; 35,000 shares to be offered for public sale for the account of the company, and 45,330 outstanding shares by the present holder thereof. Public offering price and underwriting terms to be supplied by amendment. Proceeds from the stock sale, together with the proceeds from the private sale of $750,000 in principal amount of long term notes and general funds available primarily from retained earnings, will be used to redeem all of the company's outstanding shares of 7% cumulative preferred stock at an aggregate redemption price of $41,580, plus accrued dividends; to repay the presently outstanding first mortgage note in the unpaid principal amount of $262,500, plus call premium and accrued interest; to reduce the outstanding short term bank loans presently aggregating $600,000; to purchase approximately $100,000 of new machinery and equipment for the production of torque motors; to pay a promissory note of $65,000; balance for working capital and other corporate purposes.

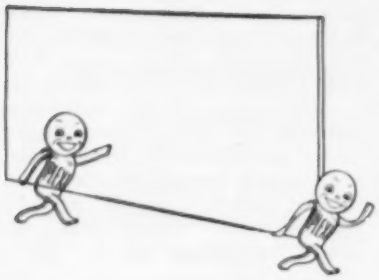
The Perkin-Elmer Corp., Norwalk, Conn., engaged in the design, manufacture and sale of precision scientific instruments which analyze chemical compounds by measurement of their distinct physical characteristics and electro-optical systems and precision optics principally for space and missile fields. Offering is 100,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Of the pro-

The phone number of your nearest Authorized PLEXIGLAS Distributor is in this list:

Atlanta, Ga.	TR-5-7006
	CE-3-3274
Baltimore, Md.	WI-7-4900
Boston, Mass.	AN-8-1900
	WA-3-9800
	NO-7-3500
	EL-4-3001
Bridgeport, Conn.	ED-3-3128
Buffalo, N.Y.	DE-9540
	MA-1873
Charlotte, N.C.	FR-6-8561
Chicago, Ill.	CL-4-4900
	FI-6-7900
	CA-7-0300
	ED-4-8115
Cincinnati, Ohio	DU-1-3010
	PA-1-7911
Cleveland, Ohio	OL-1-1500
Columbus, Ohio	CA-1-3098
Dallas, Texas	RI-7-8597
	RI-7-7044
Dayton, Ohio	BA-2-5891
Denver, Colo.	GE-3-3369
	SU-1-6361
Detroit, Mich.	TO-9-9500
Des Moines, Iowa	CH-3-8657
Ft. Worth, Texas	ED-2-7079
Grand Prairie, Texas	CR-4-7337
Hanover, Pa.	MA-4-7241
Hartford, Conn.	AD-3-9881
Houston, Texas	MI-4-5626
	OR-4-7686
Indianapolis, Ind.	ME-4-4521
Kansas City, Mo.	GR-1-0500
	LO-1-3480
	GR-1-6390
Los Angeles, Calif.	DU-5-3001
	DU-1-3053
Louisville, Ky.	ME-5-2606
Memphis, Tenn.	FA-7-7391
Miami, Fla.	PL-7-2477
	NE-5-5339
Milwaukee, Wis.	BR-6-9700
	BR-3-7032
Minneapolis, Minn.	FE-9-8917
New Orleans, La.	EX-4233
New York, N.Y.	BE-3-7377
	WO-6-4900
	OR-5-1172
	GR-7-5000
Newark, N.J.	MI-2-7413
Philadelphia, Pa.	GL-9-1000
	LO-3-7038
	WA-2-6824
	GA-6-4010
Phoenix, Ariz.	AL-2-1701
Pittsburgh, Pa.	MA-1-6854
Richmond, Va.	EL-5-5324
Rochester, N.Y.	FA-8-4115
Salt Lake City, Utah	DA-8-0648
San Antonio, Texas	CA-2-9351
San Diego, Calif.	CY-5-8261
San Francisco, Calif.	PL-6-7740
	DO-2-6433
Seattle, Wash.	MA-3-2783
St. Louis, Mo.	MA-1-7900
	JE-1-6372
St. Paul, Minn.	CA-7-7371
Syracuse, N.Y.	HA-2-9165
Tampa, Fla.	37-5121
Washington, D.C.	DE-2-9000
Wilmington, Del.	OL-4-9937

It takes just 7 seconds to contact your

AUTHORIZED PLEXIGLAS DISTRIBUTOR



In just the time it takes to dial the phone, you can obtain complete service on PLEXIGLAS® acrylic plastic. Your Authorized PLEXIGLAS Distributor can serve you with other plastics, too, and a wide range of accessories. He is also qualified to help you with technical and fabrication information. His stocks include almost any size and thickness of PLEXIGLAS in clear, colored, patterned and corrugated sheets, plus rods and tubes. Call the number listed at the left, in your nearest city. You will be connected with *your best source of service on plastics.*

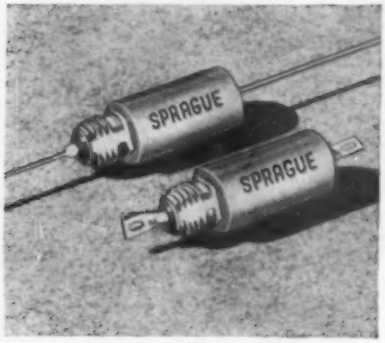
Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

In Canada: Rohm & Haas Co. of Canada, Ltd., West Hill, Ontario

Improved Interference Filter Capacitors Have Excellent Environmental and Insertion Loss Characteristics

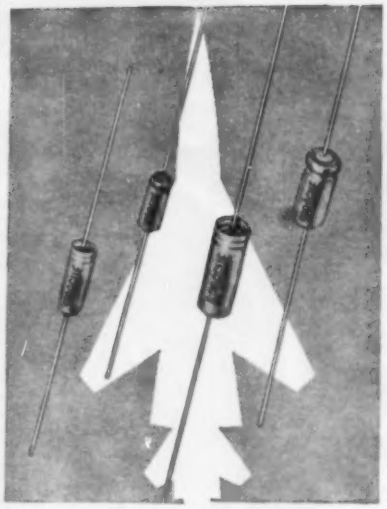


Recent technical data released by the Sprague Electric Company, North Adams, Massachusetts, reveals the unusual environmental and insertion loss characteristics of the company's subminiature Thru-Pass® Filter Capacitors. The performance of these capacitors is said to come closer to that of a theoretically ideal capacitor than any other type of paper capacitor ever made.

When properly installed, these capacitors reduce to a negligible value the effects of external cross coupling. They also provide a minimum length of path to ground for radio interference currents. Thru-Pass Capacitors are designed to meet all the electrical, mechanical, and environmental requirements of Military Specification MIL-C-11693.

Both Type 102P and Type 103P are impregnated with Vitamin Q, Sprague's exclusive inert synthetic impregnant, in order to achieve maximum insulation resistance and minimum capacitance change with temperature. Type 102P units are processed for −55 C to +85 C operation; Type 103P for −55 C to +125 C. Maximum feed-thru current for which both are rated is 5 amperes d-c continuous or equivalent.

For complete data on Thru-Pass Capacitors, write for Engineering Bulletin 8015 to Technical Literature Section, Sprague Electric Company, 327 Marshall Street, North Adams, Massachusetts.



NEW WET-ANODE TANTALEX® CAPACITORS

for 125 C operation

Another Sprague "first" for military and industrial designers—Type 130D Wet-Electrolyte Tubular Sintered-Anode Tantalex Capacitors for 125 C operation without voltage derating.

The remarkable electrical stability of these capacitors is the result of *special aging*, the use of *inert materials*, and a *low diffusion seal*. Construction is designed to meet the 2000-cycle military missile vibration requirement. Shelf life is excellent.

Shoulder-less shape makes mounting on printed wiring boards easier, avoids punching slots in boards or the use of "chairs", and simplifies board wiring layout.

For complete technical data, write for Bulletin 3701 to Technical Literature Section, Sprague Electric Co., 327 Marshall St., North Adams, Massachusetts.

SPRAGUE®
THE MARK OF RELIABILITY

ceeds, $1,400,000 will be applied to construction of a plant in Norwalk; $500,000 to the purchase of machinery and equipment; the remainder added to the general funds.

The Hallicrafters Co., Chicago, Ill., engaged in research, development and manufacture for the military of electronic equipment such as missile components electronic countermeasures equipment, fixed station communication equipment and airborne radar jamming equipment. Offering is 300,000 shares of capital stock; 100,000 shares for public sale for the account of the company, and 200,000 outstanding shares for the present holders thereof. Offering price and underwriting terms to be supplied by amendment. Proceeds of the 100,000 shares will be used to increase the company's working capital, $1,000,000 of which will be used to temporarily reduce short-term bank loans. In the near future, $500,000 of the company's funds will be used to purchase machinery and equipment and production facilities for a new plant facility in Chicago, and $250,000 for expansion of research, development, office and administrative facilities and purchases of laboratory equipment for the existing plant.

Vitramon, Inc., Bridgeport, Conn., engaged in the manufacture and sale of solid state porcelain dielectric capacitors and microminiature ceramic dielectric capacitors. Offering is 103,512 shares of common stock; 25,650 shares for public sale by the company, and 77,862 outstanding shares by the present holders thereof. Of the proceeds of the 25,650 shares: $25,000 will be used to redeem outstanding preferred; $112,500 to prepay the balance of mortgage notes; the balance for working capital.

Milgo Electronic Corp., Miami Fla., engaged in the business of designing, developing, manufacturing, and selling an integrated line of electronic equipments and systems for use in various missile and space programs. Offering is 65,000 shares of common stock, to be offered for subscription by holders of outstanding common stock at the ratio of one new share for each six shares held. Record date, subscription price and underwriting terms to be supplied by amendment. Of the proceeds, $636,500 will be used for the repayment of short-term bank loans; $200,000 for the expansion of the volume of work in process and of inventories of finished goods; $125,000 for development of certain components for use with presently existing general purpose analog computer; the balance for working capital.

SATELLITE COMMUNICATIONS ENGINEERS

Bendix now holds prime responsibility for the ADVENT program for the Signal Corps.

Opportunities are available in:

Circuit Design
Packaging
Environmental Studies
Electromechanical Design
AJ Techniques
Information Theory
System Design and Operation
Space Environment
Microwave Technology

Write today to Director of Personnel, Dept. A10-10.

BENDIX SYSTEMS DIVISION
ANN ARBOR, MICHIGAN

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Dr. C. Stark Draper, head of the Department of Aeronautical and Astronautical Engineering and director of the Instrumentation Laboratory at Massachusetts Institute of Technology, has been named recipient of The Franklin Institute's Howard N. Potts Medal for his "substantial and significant contributions to the science of inertial navigation, which have resulted in outstanding advances in the accuracy of navigation below and on the surface of the ocean, through the air and into space."

E. V. Huggins, Westinghouse Electric Corp. vice president and chairman of the executive committee, has been elected president of the National Security Industrial Assn. for the coming year.

Keith T. McLeod, superintendent of Public Weather Service, Toronto Headquarters, Meteorological Branch, Canadian Department of Transport, has been granted a two year leave of absence to serve as Senior Technical Officer (Executive Assistant) to the Secretary General of the World Meteorological Organization, Geneva, Switzerland, and as chief of the Administrative Division of the Secretariat.

Changes

Col. Clair E. Ewing, deputy commander, Pacific Missile Range Headquarters, Pt. Mugu, Calif.

Dr. Robert E. Wilson, associate technical director for aeroballistics, U. S. Naval Ordnance Laboratory, Silver Spring, Md.

Col. Harry E. Goldsworthy, site activation task force commander, Air Force Minuteman Intercontinental Ballistic Missile Base, Malmstrom AFB, Mont.

Harry A. Ferullo, chief engineer-rockets department, Bell Aerosystems Co., Buffalo, N. Y., a division of Bell Aerospace Corp. Also: **Neil A. Montone,** director of marketing, Avionics Division of Bell Aerosystems Co.; **Paul H. Butler, Jr.,** senior Dayton (Ohio) representative for Bell Aerosystems.

Raymond J. Sheehan, manager of equipment support, General Electric Co.'s Aircraft Accessory Turbine Department, Lynn, Mass. **Elmer A. McBride** succeeds Mr. Sheehan as West Coast (Los Angeles, Calif.) district manager for GE's accessory power equipment for aircraft, missiles, space vehicles and marine and ground applications.

Duane C. Manning, marketing manager, Electronics Division, Elgin National Watch Co., Elgin, Ill.

William E. Vogel, chief engineer-manufacturing research and development, Dana Corp., Toledo, Ohio.

Ted Dunnegan, Jr., acting division manager, Electronics Division, Temco Electronics & Missiles Co., Dallas, Tex., a subsidiary of Ling-Temco Electronics, Inc.

William E. Diefenderfer, assistant general manager, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn. and **Harry E. Gravlin,** operations manager. **Donald G. Richards** succeeds Mr. Diefenderfer as engineering manager.

ELECTRONIC FIELD ENGINEERS
YOU'RE IT!

When you become a FIELD ENGINEER with Convair/Astronautics you become the man with the Atlas answers . . . the technical troubleshooter . . . the man who aids the Air Force on the spot. Your greatest reward: the immediate satisfaction of coming to grips with each problem . . . of meeting and solving it at close range.

You will first be thoroughly trained in Atlas systems in San Diego. Field assignments, commanding attractive bonus allowances, will follow at Vandenberg AFB, Santa Maria, California; Warren AFB, Cheyenne, Wyoming or at Offutt AFB, Omaha, Nebraska. Other assignments will be available as additional bases are activated.

Men with engineering degrees and missile or aircraft hardware experience — men like you — are urgently needed now.

Write now to Mr. R. B. Merwin, Industrial Relations Administrator-Engineering, Department 130-90, 5559 Kearny Villa Road, San Diego, California.

CONVAIR/ASTRONAUTICS
CONVAIR DIVISION OF
GENERAL DYNAMICS

SAVE SPACE, WEIGHT AND MAINTENANCE with Versatile Compact MIL Spec Modules

For your electronic/electromechanical packaging problems, consult Oster specialists. Compact, transistorized, MIL spec, hermetically sealed, plug-in modules are available for numerous applications.

Typical building block basic units are illustrated. Temperature range is —55°C to +105°C. Basic units can be modified easily or completely redesigned to your specific requirement.

Oster engineers are specialists in creating densely packaged black boxes. These boxes can help you design more compactness and less weight into your systems. Phone or write your nearest John Oster office today.

GENERAL ENVIRONMENTAL CONDITIONS

A. Temperature—	—55°C to +75°C
B. Altitude—	—1000 Feet to +80,000 feet
C. Humidity—	Section 4.4.3 of MIL-E-5272
D. Vibration—	0.30 inch double excursion from 3 to 18 cycles per second and ± 2 g. acceleration from 18 to 500 cycles. (Without vibration isolators)
E. Crash Safety—	Repeated shocks of 30 g. with durations of 11 milliseconds
F. Salt Atmosphere—	Section 4.6.1 of MIL-E-5272
G. Fungus Growth—	Section 4.8.1 of MIL-E-5272
H. Sand and Dust—	Section 4.11.1 of MIL-E-5272

GENERAL PERFORMANCE SPECIFICATIONS

A. Gain Variation—	Less than 10% due to any given parameter extreme variation.
B. Linearity—	Better than 10% through the range of 3% to 80% of full output.
C. Noise—	Less than 5% of maximum output.
D. Phase Shift—	Less than 8 degrees.

Oster®

TYPE 9805-20—SYNCHRONIZER
Same as 9805-19 except Control Transformer Speed is 10 degrees/second—Min.

TYPE 9805-19—SYNCHRONIZER

Synchronizer

Motor Control Phase— 40/20 volts, 1.7 watts, 400 cycles
Motor Reference Phase— 57.5 volts, 2.2 watts, 400 cycles
Generator Excitation— 57.5 volts, 3.0 watts, 400 cycles
Generator Output— 0.3 volts/1000 R.N.M. Min.
Control Transformer Speed— 100 degrees/second-Min.
Control Transformer— John Oster Mfg. Co. 4053-19
Motor Generator— John Oster Mfg. Co. 6232-1

TYPE 9616-08—DEMODULATOR AMPLIFIER

Demodulator Amplifier

Input Impedance— Greater than 25,000 ohms
Output Impedance— 2830 ohms (Dual)
Voltage Gain— Greater than 115
Supply Voltage— 28.0 D.C.

TYPE 9616-07—SYNCHRONIZER AMPLIFIER

Synchronizer Amplifier

Input Impedance— Greater than 50,000 ohms
Voltage Gain— Greater than 250
Load— Control Phase of Motor Generator of 9805-19 or 9805-20

TYPE 9616-16—4-CHANNEL ISOLATION AMPLIFIER

4-Channel Isolation Amplifier

Input Impedance— 1200 ohms per channel
Voltage Gain— .98 ± .01 per channel
Load Impedance— 1200 ohms per channel
Supply Voltage— 48VDC

TYPE 9616-09—SERVO ACTUATOR AMPLIFIER

Servo Actuator Amplifier

Input Impedance— Greater than 50,000 ohms
Output Impedance— 400 ohms
Voltage Gain— Greater than 900
Supply Voltages— 100.0 volts D.C. 28.0 volts D.C.

TYPE 9616-15—RELAY AMPLIFIER

Relay Amplifier

Input Impedance— Greater than 15,000 ohms
Relay Closing Voltage— 150-175 Millivolts, 400 cycles
Relay Opening Voltage— 125-150 Millivolts, 400 cycles
Relay Contacts— 4 Pole, Double Throw—Dry Circuit
Supply Voltage— 28.0 V. D.C.

TYPE 9616-06—SUMMING AMPLIFIER (DUAL)

Summing Amplifier

Summing Inputs— 10 (per channel)
Gain— Nominal 1.0; variable from 0.1 to 10.0
Input Impedance— Dependent on Summing Channel. (50,000 ohms—500,000 ohms)
Load Impedance— Greater than 10,000 ohms
Supply Voltage— 28 V. D.C.

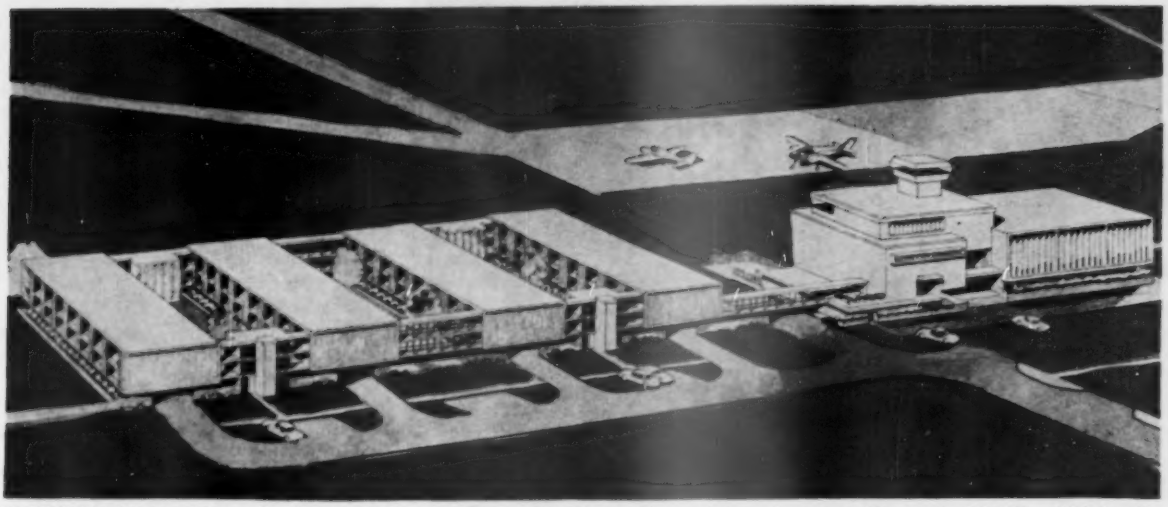
John Oster MANUFACTURING CO.
Specialists in Instrumentation and Display
Avionic Division
Racine, Wisconsin

OTHER PRODUCTS INCLUDE:
Servos, Synchros, Resolvers, Motor Tachs, DC Motors, Computers, Indicators, Servo Mechanisms, Servo Torque Units

EASTERN OFFICE
310 Northern Blvd.
Great Neck, Long Island, New York
Phone: HUnter 7-9030
TWX Great Neck N.Y. 2960

WESTERN OFFICE
5333 South Sepulveda Blvd.
Culver City, California
Phone: EXmont 1-5742 • UPton 0-1194
TWX S. Mon. 7571

Engineers For Advanced Projects: Interesting varied work on designing transistor circuits and servo mechanisms.
Contact Mr. Dallas Nielsen, Personnel Manager, in confidence.



EXECUTIVE AIRPORT being developed by Sphere, Inc., near Ft. Worth, Tex., will have four-story office-terminal building (right) and a motor hotel (left). The new airport will provide hangar space and facilities for 240 aircraft.

Executive Airport Planned for Ft. Worth

By Erwin J. Bulban

Ft. Worth, Tex.—First step toward construction of an $8 million executive airport, which is planned for basing 240 aircraft, was taken here with signing of a contract between Sphere, Inc., and Tyson Steel Building Co., for erection of 26 prefabricated buildings.

Construction of the new 650-acre airport designed exclusively for business and private aircraft will begin early in 1961, according to a spokesman for Sphere, Inc., which is developing the project.

Final completion is scheduled for March, 1962.

Facilities will include a 6,000-ft. instrument runway and two 3,000-ft. runways, a terminal building, a 128-unit motor hotel and control tower. The airport will be located some 8 mi. south of Ft. Worth, adjacent to a 25,000-acre industrial development.

Lease-Purchase

Financing of the project will be a lease-purchase proposition. A syndicate of New York real estate interests is purchasing the land, buildings and other facilities and leasing these back to Sphere, Inc., a Texas corporation headed by a group of Ft. Worth, Dallas, Beaumont and Denton businessmen and industrial executives. Sphere, Inc., in turn, acting as a "landlord," will lease facilities to fixed base operators, retaining control over fuel concessions, although the operators will pump gas at each of their individual facilities.

This lease-purchase of facilities is believed to be new in the airport field, although it has been increasing in volume in other aspects of the transportation industry because of the attractive features it offers in reducing capital expenditures and tax benefits.

Growth potential of the area is cited by Sphere, Inc., executives as the reason for their optimism in the project's success. Not only is the new field situated in a strategic area which is undergoing industrial development, but surveys of corporate aircraft activities in the state also point toward a good future. At nearby Meacham Field, for example, a survey shows that plane movements there are expected to reach some 192,000 in 1970 compared with approximately 155,000 now and that the number of aircraft based there will grow to about 400, more than double the current figure.

Sphere, Inc., also is studying future development of its operation beyond the airport. Indications are that plans include development of a basic and applied research facility and entering the business aircraft design and production field. The latter is seen as occurring "in the next five years."

Hangar Facilities

Hangar facilities to be built include two buildings, each composed of six complete hangars, 130 ft. x 122 ft., with a clear opening of 120 ft. and a 30-ft. tail clearance. Shop and office space will separate each hangar to provide individual operating space. Over-all length of each building will be 1,000 ft.

In addition, 24 T-hangars will be erected; one group having a clear opening of 40 ft. x 12 ft. x 32 ft.; the other of 54 ft. x 16 ft. x 40 ft. The smaller sizes will house aircraft from Cessna 310s down; the larger will handle planes in the Twin Beech and Aero Commander class. A Tyson Steel agent noted that the $2 million contract signed with Sphere is the largest of its kind

Safety Awards

Los Angeles—National Business Aircraft Assn. honored 217 top business pilots for flying a total of 215,106,812 mi. without scratching their aircraft or injuring passengers or crew.

Awarded safety certificates during NBAA's 13th annual meeting and forum were 96 pilots who have flown 1 million mi. or more without a single injury and 121 pilots who have flown 500,000 mi. or more safely.

In addition, 58 of the leading U.S. business and industrial firms were cited for their perfect business aviation safety records, having flown 1 million mi. or more without incident. One company, Goodyear Tire & Rubber Co., Akron, Ohio, has logged more than 6 million mi., four firms have records of more than 5 million mi. each, four have flown more than 4 million mi. each, 12 have flown more than 3 million mi. each and 14 were recognized for having completed more than 2 million mi. each in their executive aircraft.

• *Advanced hydrogen systems being developed by The Garrett Corporation solve the problem of keeping men alive and equipment operating for long periods of time in future satellites and space capsules.*

Engineers at The Garrett Corporation's AiResearch Manufacturing Divisions are dealing with challenging problems in fast-moving fields.

Diversification of effort and vigorous leadership have made Garrett the world's largest manufacturer of aircraft components and systems and a leader in specialized missile and spacecraft systems.

Major fields of interest are:

- Environmental Control Systems—Pioneer, leading developer and supplier of air conditioning and pressurization systems for commercial and military aircraft, and life support systems for satellites and space vehicles.
- Aircraft Flight and Electronic Systems—Largest supplier of airborne centralized flight data systems; also working with other electronic controls and instruments including missile and submarine applications.
- Missile Systems—Largest supplier of accessory power units, AiResearch is also working with hydraulic, hot gas and hydrogen systems for missiles, liquid and gas cryogenic valves and controls for ground support.
- Gas Turbine Engines—World's largest producer of small gas turbine engines, with more than 9000 delivered in the 30–850 hp class. Studies include industrial and nuclear applications.

Excellent positions are available for qualified men with M.S., Ph. D. and Sc. D. degrees for work in these areas.

Send resume to: Mr. T. E. Watson

THE GARRETT CORPORATION
AiResearch Manufacturing Divisions
Los Angeles 45, California • Phoenix, Arizona

handled by his company. Tyson is Ft. Worth franchised dealer for Inland Steel Products Co.

It is expected that the airport will be operational by Oct. 31, 1961, with the terminal and motel buildings to be in by the scheduled over-all completion date the following year. Sphere, Inc., currently is negotiating lease agreements with tenants for the hangars and will lease the motel to a national chain operation. Selection of an airport manager is also under consideration.

Operation is planned on a 24-hr. basis, with complete servicing, sales and storage facilities. Terminal building will include a private club, business conference room and restaurant seating 175.

Officers of Sphere, Inc., include Raymond H. Beyer, president; Preston C. Crysel, board chairman and vice president; Roy R. Beyer, executive vice president; Stephen J. Holland, secretary; Richard J. Montgomery, vice president and D. T. Day, treasurer.

Architect-engineers on the project are Harkrider, Clark and Jones, Ft. Worth. Finances are being handled through Owen W. Sherrill, Georgetown, Tex., and Nathan Whitkind, N. Y. C.

Interior Modified In New Comanche Models

Lock Haven, Pa.—Interior refinements mark the new 1961 models of the four-place Comanche business plane on which Pipe Aircraft Corp. is starting deliveries to dealers this month.

Important changes over last year's model include revised instrument panel layout, installation of a three-axis autopilot and automatic radio direction finder, toe brakes to supplement the hand brake as standard equipment, increased payload and improved cabin heating and ventilation.

The Comanche 250 also is available with a 90-gal. fuel capacity, an increase of 30 gal. over previous models, providing more than 6 hr. range at 181 mph. maximum cruise speed or 12-hr. range at 137 mph. economy cruise speed. Gross weight for the 250-hp. version also is up 100 lb., providing a permissible useful load of 1,270 lb.

New model's instrument panel layout is similar to that used on the light-twin Apache. Basic instruments are located on the left side, in front of the pilot, engine gages are relocated to the extreme right and radio equipment is centered for optimum access by either front seat occupant. A control console for cabin air flow and temperature also is located on the panel.

Piper offers the two-axis autocontrol system as standard equipment on the Comanche, but this year is providing, as optional equipment, a three-direc-

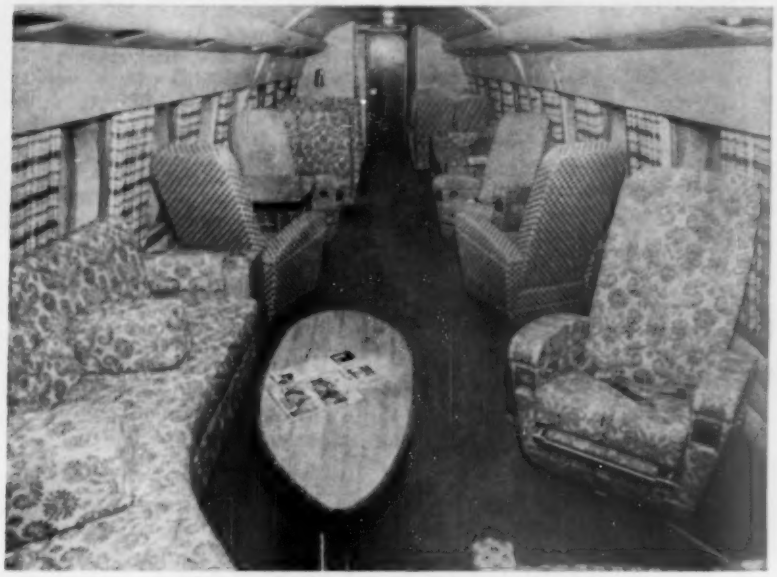
tional all-transistorized autopilot system, including pitch control, course selector, heading lock, altitude preselect scale and altitude hold. This new equipment costs $1,245 additional.

Standard on the 1961 Comanche are toe brakes on the left side, supplementing the hand brake. Safety valve prevents either brake system from being engaged in flight.

The 1961 line is offered, as usual, in four models—Standard, Custom, Super Custom and Autoflite. Standard version includes basic instruments and lights. Custom model includes an advanced gyro panel and radio-navigation package consisting of a 12-channel Narco Superhomer for VHF communications and omni navigation and the Piper Autonav LF RDF direction finder. Super Custom replaces the Superhomer with a Narco Mk. V, 90-channel transmitter (190-channel crystal-controlled receiver for VHF communications, coupled with Narco VOA-3A omni converter and CS-3 VOR) ILS navigation indicator. The Autoflite version has all of the Super Custom's equipment, plus the Piper Autocontrol autopilot.

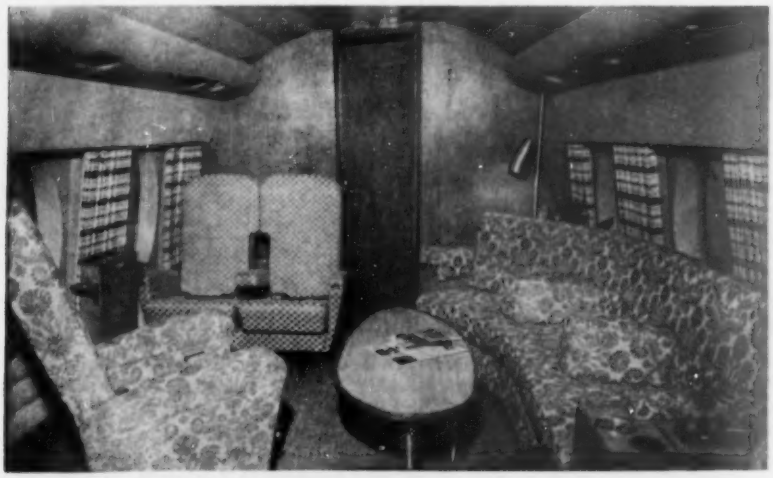
Southwest Airmotive Shows 40% Sales Gain

Dallas, Tex.—Gross sales increase of 40% for the fiscal year ended May 31 over the similar fiscal period last year is reported by Southwest Airmotive Corp., a major business aircraft service center here. Total sales for the year



Private Viscount Modified

Private Vickers Viscount is shown after modification by The Garrett Corp.'s AiResearch Aviation Service Division, Los Angeles. The four-engine turboprop, modified to accommodate 22 passengers and a crew of five, is equipped with reclining swivel seats with extendable leg rests, sleeping divan, additional lavatory and new forward galley.



TECHNICAL WRITERS

If word-smithing is your business, and space is your interest, Convair-Astronautics has an immediate position for you. Assignments involve the creation of maintenance, operation and inspection manuals for the top priority ATLAS ICBM weapon system.

Requirements: two years of college engineering, technical writing experience, plus an eye for the incisive word.

Write now to Mr. R. B. Merwin, Industrial Relations Administrator-Engineering, Department 130-90, 5562 Kearny Villa Road, San Diego, California.

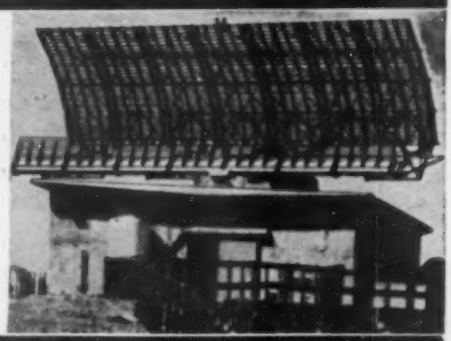
CONVAIR/ASTRONAUTICS
CONVAIR DIVISION OF
GENERAL DYNAMICS

Marconi's offer a complete consultancy and engineering service in the installation of radar systems. All Marconi radars and data handling equipment have been designed for integration into the most advanced air traffic control and defense systems at present in operation or contemplated in the foreseeable future. Marconi radar is in constant use in 36 countries.

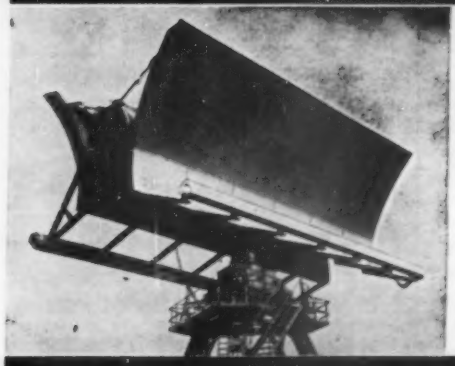
MARCONI'S

AIR TRAFFIC CONTROL SYSTEMS

The Marconi S264A 50 cm. radar is the most advanced air traffic control radar in the world. It will operate anywhere, including mountainous country, in all weather conditions. It is designed for the control of jet aircraft from take-off to 150 miles plus, combining the three roles of Airfield Control, Terminal Area Control and Long Range Airways Surveillance. Several versions are now available to suit varied circumstances and continuous research is being devoted to ensure continued progress and development of Marconi 50 cm. radars.



cover the whole field



LONG RANGE SURVEILLANCE RADAR

This versatile radar can be adapted to a diversity of applications. The Moving Target Indicator eliminates the echoes from stationary objects. Distortion of the reflector profile is prevented by the main member being a 6′ 8″ diameter tube, thus giving increased accuracy over a longer life. A unique mechanical design feature ensures that the turning gear is unaffected by slight subsidence of the site. Like the S244 the equipment is 'all weather' and 'all climate' and will withstand wind speeds up to 120 knots without 'radoming'.

of ground radar

LONG RANGE HEIGHT FINDER

The Marconi S244 is the most advanced and accurate height finder in the world. In conjunction with the Marconi control system it can handle 15 random targets per minute. Height references are related to a shock mounted artificial horizon which overcomes the instabilities inherent in all large supporting structures and gives the greatest known accuracy. The equipment operates satisfactorily in all weathers and climates from Arctic snows to tropical monsoon precipitation. It may be 'radomed' for protection but will withstand wind speeds up to 120 knots without 'radoming'.

MARCONI

COMPLETE CIVIL AND MILITARY RADAR SYSTEMS

SURVEYED · PLANNED · INSTALLED · MAINTAINED

Mr. J. S. V. Walton, Marconi's Wireless Telegraph Company Limited
Suite 1941, 750 Third Avenue, New York 17, N.Y., U.S.A.

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED · CHELMSFORD · ESSEX · ENGLAND

BIC

totaled $12,541,889, with net income being $426,358 compared with income of $393,109 the preceding year.

Income actually would have been higher except for heavy expenditures for specialized tooling and equipment for overhaul of large jet engines which the company utilizes on contracts it has with Braniff, Eastern and National for their J75s, indicating that with business during the current 1960-1961 fiscal period remaining at the same high levels, as expected, the next annual statement will show even more favorable increases in earnings.

Business in the fiscal period reported was divided almost equally among business plane, airline and military markets, with biggest gains made in sales to the airlines. This was especially reflected in sales by Southwest Airmotive's Distribution Division of $5,120,344, an increase of nearly $2 million over the previous year. Much of the increase is credited to the large volume of parts and supplies sold to the airlines who have been provisioning themselves for their new jet fleets, and the division's increased sales effort in the business airplane and attendant service base fields. The company experienced a 40% increase in piston engine overhauls in the past year.

PRIVATE LINES

Russia's Ministry of Public Health is being assigned a fleet of coaxial Kamov Ka-18 helicopters for ambulance service and emergency medical aid in the Moscow area (AW Aug. 1, p. 51). The craft will be based at Moscow Central Airport, near the center of the city, but also will be able to land at new heliports on the grounds of several Moscow hospitals. Mi-4 helicopters based at Central Airport already provide scheduled passenger service to Moscow's major airfields.

Supplementary type certificate has been awarded by Federal Aviation Agency for the pressurized Lockheed Super 26, a B-26 modified by Lockheed Aircraft Service. Military fuselage has been redesigned for enlarged 22 ft. long cabin structure with 6 ft. headroom, lavatory and other equipment. Rear wing spar has been replaced with a forged steel fuselage ring to which wing attachments are fastened.

Championship trophy for 6th annual sailplane regatta at Harris Hill, Elmira, N. Y., was awarded to Don Wilson, Welland, Ont., a member of the Southern Ontario Soaring Assn., flying a Schweizer 1-26. Jim Norton, of Mohawk Soaring Club, Schenectady, N. Y., won the sailplane assembly race, completing assembly in 7 min. 24 sec.

CAB Accident Investigation Report:

Pilot Instrument Inexperience Cited by CAB in Beech Crash

A chartered Beechcraft, Model C18-S, crashed near McGrath, Alaska, on Sept. 1, 1959, about 2214 AST, killing all eight occupants.

The aircraft departed Kotzebue for McGrath, both in Alaska, at 1315 AST, with nonrefueling stops at Kiana and Tanana. At Tanana, Pilot Chefley W. Priest was briefed on en route weather to McGrath as well as on the route and terminal forecasts. He departed Tanana at 1957 AST, about an hour before sunset, on a VFR flight plan.

An emergency distress call from the aircraft was first heard at 2128 AST. There followed several communications between the Beechcraft and the McGrath ground station which issued navigational advice. At or about 2214 AST, approximately three-quarters of an hour after dark and during rain showers, the aircraft struck the ground violently in a steep spiral at a point about 26 mi. from the McGrath Airport. This accident appears to have been caused by the pilot's loss of control during instrument flight and his failure cover.

Investigation

The purpose of the flight was to transport a group of six young women and their manager, engaged in selling magazine subscriptions, from Kotzebue to Anchorage. At Kotzebue the aircraft was fueled to its capacity of 206 gal. of gasoline and 7½ gal. of oil. Upon departure from Kotzebue at 1315[1] the gross weight of the aircraft was computed to be approximately 8,600 lb. The maximum certificated gross weight for this aircraft is 7,850. The aircraft landed at Kiana at 1350, departed there at 1525, and then landed at Tanana at 1726 for a stop of approximately 2½ hr., but no fuel was added at either place although available at both places. While at Tanana, Pilot C. W. Priest was furnished the existing and forecast en route weather by an FAA airways operations specialist.

Departure from Tanana was at 1957, about an hour before dark, on a VFR flight plan in which the pilot estimated a flying time of 1 hr. 30 min. to McGrath and fuel for 2 hr. 30 min. McGrath is about 166 mi. to the southwest of Tanana.

Nothing was heard from the Beechcraft after leaving Tanana until approximately 2128 when an Air Force reconnaissance flight identified as "Loon Hotel" intercepted a Mayday call from it on the emergency frequency of 121.5 mc.

Loon Hotel immediately notified McGrath radio of the Mayday call which McGrath had not heard. Attempts were then made by McGrath to contact the Beech on all frequencies available but with no success.

At 2135 McGrath heard the Tatalina Aircraft Control and Warning Site (about 12 mi. west-southwest of McGrath) call the Beech on 121.5 mc. McGrath asked Tatalina if contact had been established with the aircraft transmitting the Mayday call. Tatalina advised being unable to establish two-way communications and that it did not have the aircraft on radar.

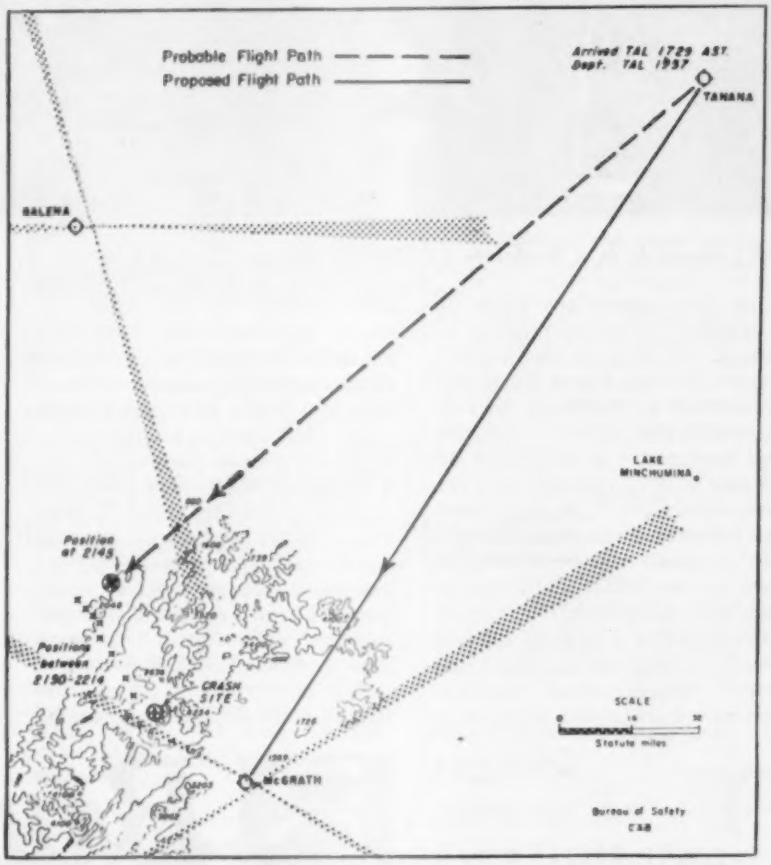
On Scope

At approximately 2145, the aircraft appeared on the Tatalina scope and Tatalina began broadcasting the bearing and distance of the aircraft to McGrath in the blind. At this time on their radar the Beech was 54 mi. north-northwest of McGrath on a southwest heading. At 2150 McGrath began broadcasting in the blind on 350 kc. range frequency and 122.2 mc., the steers being given by Tatalina on 121.5 mc.

At 2157 McGrath established two-way contact with the Beech on 121.1, 122.2 mc., and continued to give bearing and distance position reports as intercepted from Tatalina, starting at the time the aircraft was 110 deg. and 49 mi. from McGrath. At 2158 McGrath broadcast the following steers to the aircraft: 108 deg. and 47 mi., 106 deg. and 41 mi., 102 deg. and 36 mi., which the flight acknowledged.

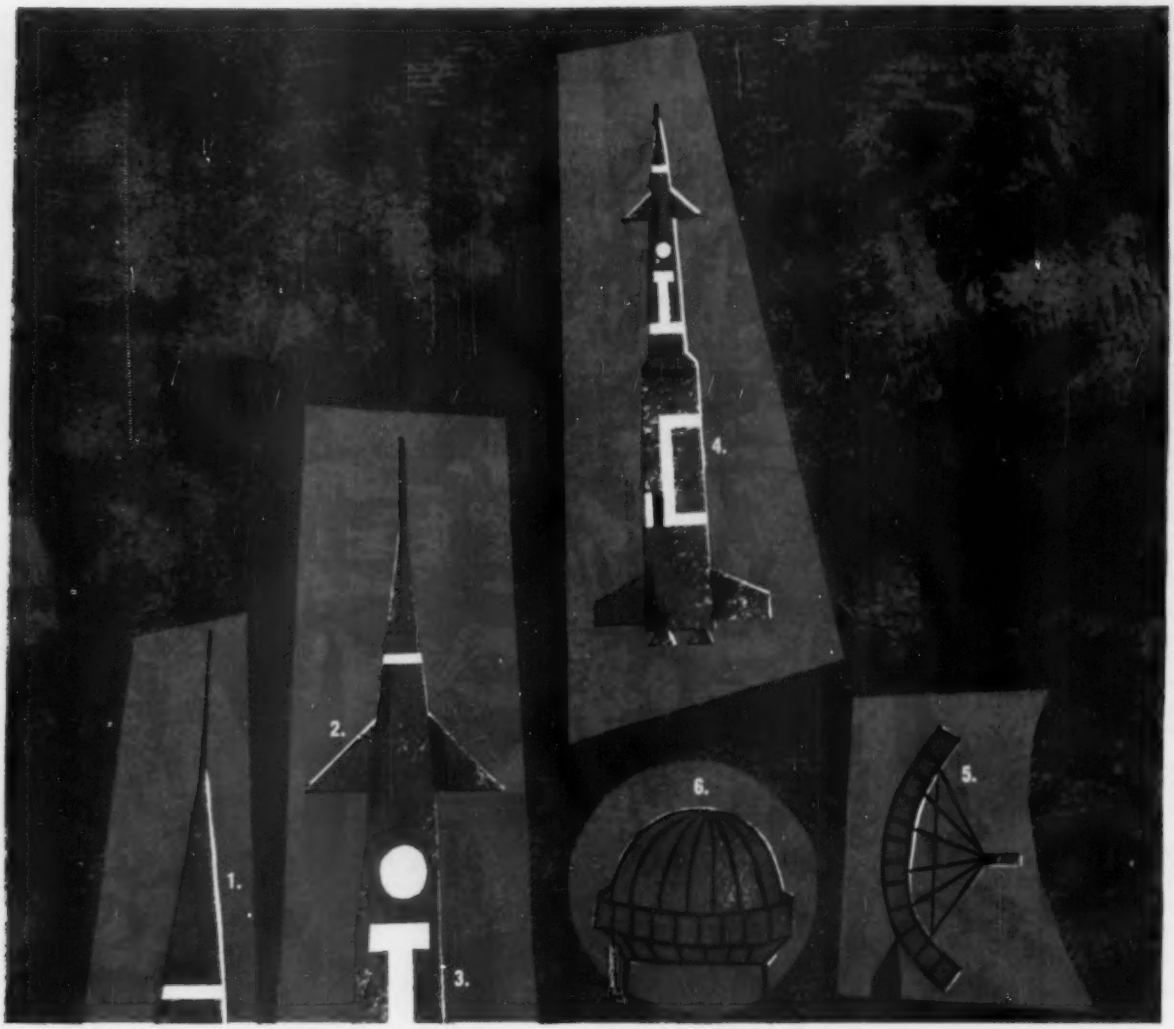
At 2204 McGrath advised the Beech to maintain a heading of 102 deg. and that it was 36 mi. from McGrath. McGrath then also asked the nature of the emergency and the pilot replied that he was low on fuel and in rain showers.

At 2207 McGrath advised the pilot to maintain a heading of 100 deg. and informed him that he was 32 mi. from McGrath. The pilot stated that he then had the field in sight and requested terrain information between his aircraft and McGrath. McGrath reported that from the information received from Tatalina they believed his aircraft to be in the vicinity of Cloudy Mountain, which is 4,200 ft. above sea level. McGrath radio also informed the flight that to the south Takotna Mountain and the Kuskokwim Mountains rose to approximately 3,100 ft. and 2,300 ft. altitudes, respectively, and that to the north of Cloudy Mountain the terrain was slightly higher. The 2155 weather report was then given to the aircraft and McGrath requested



PROPOSED and probable flight paths of C18-S are shown en route to McGrath, Alaska.

[1] All times herein are Alaska Standard based on the 24-hr clock.



BRUNSWICK OFFERS COMPLETE CAPABILITY FOR AEROSPACE PROJECTS

"Complete capability" sums up Brunswick's ability to produce results at any stage of missile development. From in-house design and production to thorough testing, Brunswick brings to each new job a vast background in successful development of components and primary structures. **1. In nose cones and radomes,** Brunswick designs and materials can be tailored to meet rigorous new requirements for high temperature electrical and ablative purposes. **2. In wings and fins,** Brunswick engineering allows new plastic structures and antennas utilized in combination for more design freedom with maximum efficiency. **3. Missile bodies** constructed by the Strickland "B" fiber glass filament-winding process offer exceptional values in weight-strength ratios while meeting design requirements for unusual shapes and sizes. **4. Brunswick rocket motor cases** constructed by the Strickland "B" fiber glass filament-winding process consistently demonstrate superior properties, whether large or small. *Pressure vessels* designed by Brunswick can deliver an S/D ratio as high as 2,000,000. **5. Reflectors** of metal honeycomb or plastic construction are designed and manufactured to meet close tolerance and conform to the highest standards of quality and performance. **6. Ground radomes** are readily available for ground support applications. Constructed of solid laminate, honeycomb core, or foam, they are standard production design at Brunswick. From the starting line, or at any stage of the development race, Brunswick's complete capability is ready to make your ideas work faster and better. Call on Brunswick's ability to produce results. Brunswick Corporation, Defense Products Division, 1700 Messler Street, Muskegon, Michigan.

MAKES YOUR IDEAS *WORK*

Brunswick

DEFENSE PRODUCTS DIVISION • 1700 MESSLER STREET • MUSKEGON, MICHIGAN

the pilot to confirm that he had the field in sight. He replied, "Roger, have your field in sight."

At 2211 the pilot requested the height of Cloudy Mountain and McGrath replied, "Approximately 4,200 ft." and inquired if the pilot had a chart. He replied, "Yes, —what is the altimeter?" McGrath gave the altimeter as 29.84, after which the pilot replied, "Boy, I need some altitude." At Tanana, the last stop, the altimeter setting was 29.70.

At 2214 McGrath, using information obtained from Tatalina, advised Priest that his heading to McGrath was 100 deg. and that he was now 26 mi. from the airport. McGrath then asked for his present altitude to which the pilot replied, "At 5,000 ft., in the soup, boy I am really in it. Radar will have to get me down."

This was the last radio contact between McGrath radio and the Beech, and at this time Tatalina lost radar contact with the aircraft. McGrath attempted repeatedly to re-establish contact without success.

The Beechcraft wreckage was located on Sept. 2, 1959, at 0742 by Air Force Search and Rescue aircraft 26 mi. north-northwest of McGrath at the approximate location the aircraft had disappeared from the Tatalina radarscopes. The aircraft wreckage was confined to a small area. At the time of impact the nose was down sharply; the right wing was down appreciably; the direction of impact was 227 deg. magnetic. Propeller pitch setting, power settings, and other information needed to reconstruct the final few seconds of flight were not determinable. Owing to severity of impact it was not possible to learn if there had been a malfunction of any component prior to impact, although all major components were accounted for at the crash site which was at an elevation of 1,800 ft. above sea level.

Not Refueled

As the aircraft had not been refueled at either Kiana or Tanana, the entire flight from Kotzebue to the accident site had been made on 206 gal. of fuel. The total flight time from Kotzebue to Tanana to the accident site was 5 hr. 36 min.

Investigation disclosed the following relative to weather conditions: Between Tanana and McGrath, during the period from 1900 to 2300, there were broken to overcast cloud layers based at 3,000 to 4,000 ft. above mean sea level along the entire route. There were also patches of broken stratus occasionally forming near 1,500 ft. Visibility was at least 10 mi. except when briefly restricted to 2 mi. in very light rain or drizzle. The tops of the cloud layers were at 14,000 ft. above mean sea level over Tanana, sloping to 6,500 over McGrath. The freezing level was at 5,000 ft. above mean sea level over Tanana, sloping to 3,500 ft. over McGrath.

Surface winds along the route were westerly at less than 5 kt., becoming northwesterly 10 kt. at 2,000 ft. and northerly 10 to 15 kt. between 5,000 and 10,000 ft. above mean sea level. Over the northern two-thirds of the route occasional light icing would have been experienced in the clouds above the freezing level to 11,000 ft. Turbulence was unlikely except for possible light turbulence near Tanana. Over the remainder of the route and in the McGrath area light icing was present in the clouds and in precipitation above the freezing level.

A very light rain began to fall at McGrath at 2100 and approximately 15 min. before the accident the observation at McGrath gave a measured ceiling of 4,000 ft., overcast; visibility 20 mi. plus, very light rain. Cloud heights at the U. S. Weather Bureau station at McGrath are measured by means of a fixed-beam ceilometer.

Pilot Priest had more than 100 hr. experience flying this model aircraft and had approximately 6,500 hr. of total pilot time, much of it over Alaskan wilderness. He held a commercial pilot certificate with multi-engine land and sea ratings. His last physical examination was passed in June 1959, at which time he had a total of 6,500 hr. He did not have an instrument rating.

Aircraft Status

The last 100 hr. and periodic inspection on the aircraft was on Mar. 25, 1959, at which time the aircraft was certified as airworthy. No further maintenance entries were made in the logbook. However, the logbook reflected flight time on the aircraft through June 30, 1959, and on that date 19 hr. had been flown since the previously mentioned 100-hr. inspection. Investigation disclosed that the aircraft had made several flights since that date for which no entries had been made. Although certified as airworthy, there was testimony by the service attendant at Kotzebue of signs of considerable oil leakage. Seven and one-half gallons of oil were added at Kotzebue

CHARLES E. McGINNIS
CHIEF COMMUNICATIONS ENGINEER

"Did I mention that Orlando's average February temperature is 62 degrees —August average is 82 degrees?" CAREER OPPORTUNITIES IN FLORIDA. Participate in creative assignments on Army, Navy and Air Force prime contracts—including Pershing, Bullpup, GAM-83 and Lacrosse missiles, Missile Master and other electronic systems. Current openings in design, development, fundamental and applied research, reliability, quality, systems test, manufacturing and associated engineering areas. Write C. H. Lang, Director of Employment, The Martin Company, Orlando 8, Florida. SEE PAGE 109

WORK IN THE CLIMATE OF ACHIEVEMENT

MARTIN
ORLANDO

PHYSICAL METALLURGISTS

Join one of industry's most progressive teams in exploring the metallurgical frontiers of supersonic flight.

Here are unusual opportunities in applied research for experienced metallurgists who would like to assume increased responsibility and expand their "sphere of influence."

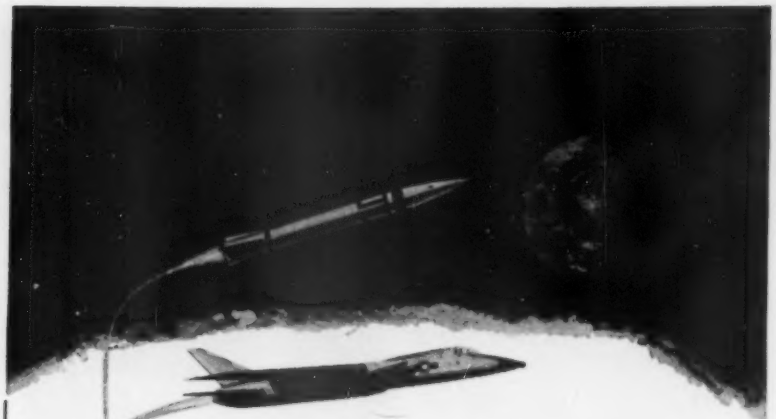
Successful applicants must have the ability to organize and direct the work of others. These positions afford exceptional opportunities for advancement in an expanding materials development program.

Background Preferred: Graduate Metallurgical Engineer with at least four years experience including development or application work in one or more of the following specialties:

Titanium Alloys
Hot Work Die Steels
Superalloys
Refractory Metals
Mechanical Metallurgy
(Sheet Metal Forming)

For more information please write to: Mr. A. K. Bowman, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
NORTH AMERICAN AVIATION, INC.



SYSTEMS ENGINEERS

here is your opportunity
to join one of the most
complete centers of
advanced systems capability

The Columbus Division of North American Aviation is a center of *total* systems capability. It is the designer and builder not only of aircraft—such as the A3J Vigilante and the T2J Buckeye—but also of missiles, radio/radar telescope systems, seat ejection systems, and other diverse products. The Columbus Division is also the center of extensive advanced R & D projects. Here, there are unlimited opportunities to contribute to advanced technology—and to forward your own career.

Currently, the Columbus Division has openings for SYSTEMS ENGINEERS. These engineers will assume responsibility for airframe electronic systems. To qualify for these positions, men should have a background in one or more of the following fields: ECM, radar, packaging, reliability, antennas, data processing, reconnaissance or associated systems and components, and design of logic digital computers. They should have a BSEE, or the equivalent, plus three years experience.

If you meet these qualifications, and seek an opportunity to advance your career, please contact us right away. Send a brief resume in confidence to:

Mr. J. A. Hitchcock
Engineering Personnel, Box AW-387
North American Aviation, Inc.
Columbus, Ohio

THE COLUMBUS
DIVISION OF
NORTH AMERICAN AVIATION, INC.

to bring the oil supply to the proper quantity of 16 gal. The aircraft was equipped with VOR, VHF, ILS, LF/MF, and marker beacon receivers and a VHF transmitter.

Analysis

It is impossible to relate this accident directly to the mechanical condition, including high oil consumption, of the aircraft. The aircraft was markedly overweight upon departure from Kotzebue. However, the aircraft was under its maximum gross weight of 7,850 lb. by about 450 lb. at the time it crashed inasmuch as it was either completely, or very nearly, out of fuel.

The series of events culminating in the crash of this aircraft cannot be definitely established. Approximately the last three-fourths of an hour of flight was in darkness, over a wild and uninhabited region completely without lights, and under an overcast. There was no ADF in the aircraft as it had been removed for repairs and Priest was therefore limited to using the low-frequency radio ranges. Under these conditions navigation would have had to be by dead reckoning or by reference to low-frequency ranges. Pilot Priest had nearly 2½ hr. of fuel upon leaving Tanana for a flight that he estimated would take about 1½ hr. However, he became lost and consumed considerable time and fuel before reaching the general vicinity of McGrath. Based on conservative fuel consumption figures the fuel would have been, or almost, exhausted at the time of the accident. After receiving terrain altitude information from McGrath the pilot climbed into the overcast to ensure ground clearance. Shortly thereafter he gave the message, "At 5,000 ft. in the soup, boy am I really in it. Radar will have to get me down." This message indicates that he had climbed into adverse weather.

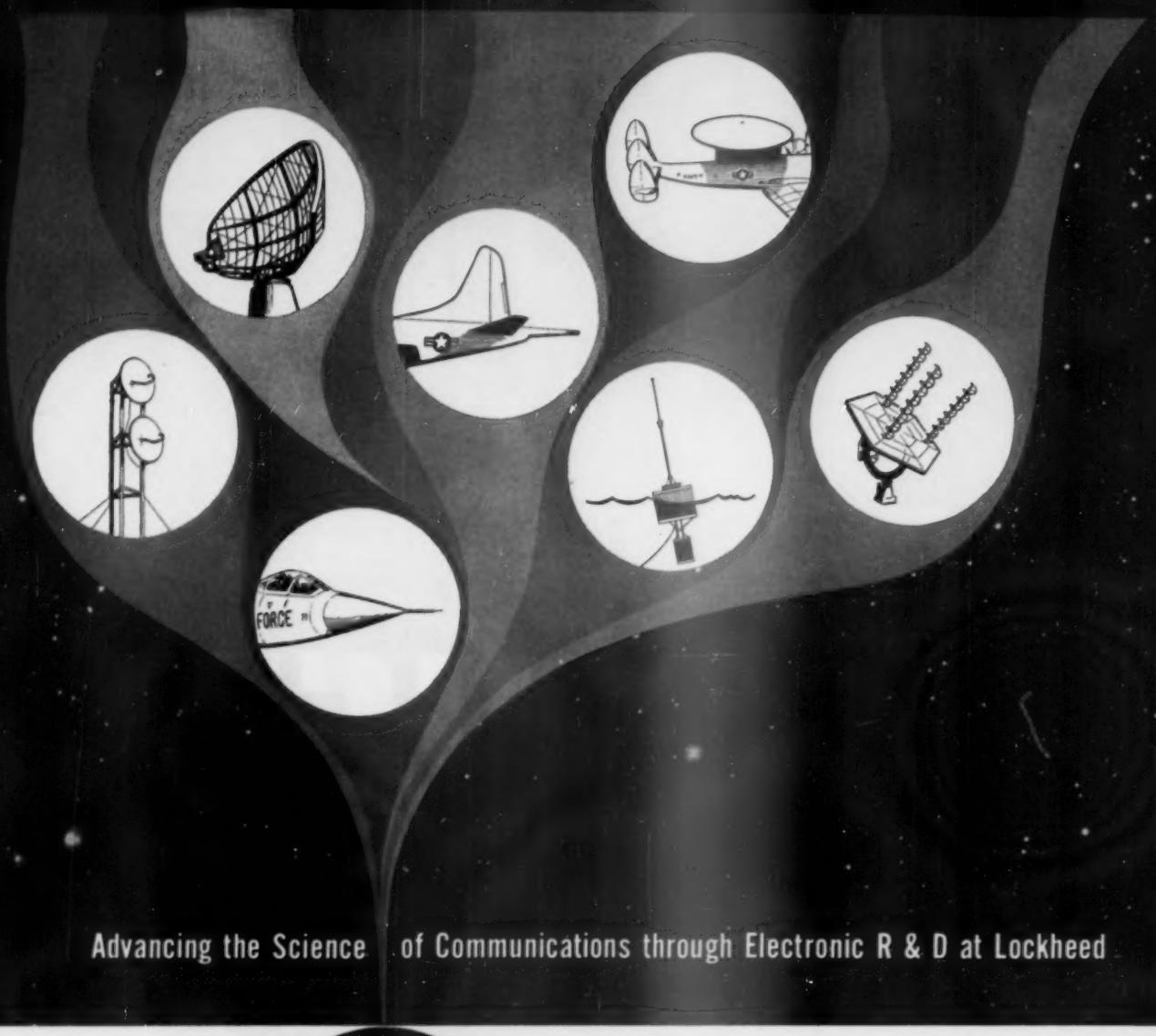
Not IFR Qualified

Pilot Priest was then in a very dangerous position. Although the record indicates he had some practical experience with instrument flight, he obviously was not able to cope with existing circumstances. Accordingly, the Beechcraft was shortly in a tight, fast, steep spiral from which, because of his limited instrument experience, Priest was unable to recover.

The localized wreckage and its extreme disintegration confirm impact following a fast steep spiral. The very brief fire which followed the crash also suggests that there was little or no fuel left in the Beechcraft's tanks.

Inasmuch as all major components of the aircraft, were accounted for at the crash site, it is logical to conclude that there was no inflight failure of the aircraft.

Possibly Priest did see the lights of McGrath, as he said, but lost them as he descended and a hilltop blocked vision. It is extremely unlikely that he could have seen other lights which he mistook for McGrath, as there were no clusters of lights between him and McGrath. It is also unlikely that he could have seen the lights of Tatalina Aircraft Control and Warning Site as it was hidden by a hill. The weather he encountered was substantially as forecast and the flight, therefore, should not



Advancing the Science of Communications through Electronic R & D at Lockheed

The extent of the science of communications is as vast as the universe itself will allow. Fresh areas in this science are being explored at Lockheed. Our pursuits cover the spectrum of communications problems—on and under the water to tracking missiles and satellites—from components to complete systems. ■ One essential phase in the electronics communications R & D program is the development of antennas and supporting equipment to receive telemetered, tracking and relay data—each uniquely designed to answer a particular need. This program is vital to support our sophisticated spacecraft projects—now and in the future. ■ Areas under investigation in electronics and other fields excite the creative mind: Design and development of data processing equipment; V/STOL design and development; electromagnetic research in corona and high-altitude breakdown studies, surface wave generation, antenna vehicle interaction, millimeter wave radiometry; electrical instrumentation; infrared and solid state physics; biophysics research (on radiation hazards coincident with space flight); solid state electronics; underwater sound propagation and oceanography studies; aerothermodynamics; dynamics; autocontrols; and servosystems are but a few of them. ■ Scientists and Engineers: The challenges and rewards of our current and future programs are unlimited. If you are experienced in any of the areas mentioned above you are invited to investigate opportunities offered by a company that always looks far into the future. Write today to: Mr. E. W. Des Lauriers, Manager Professional Placement Staff, Dept. 1110, 2406 No. Hollywood Way, Burbank, California.

LOCKHEED / CALIFORNIA DIVISION

SIXTH ANNUAL
Aviation Week

BUYERS'

THE ONLY COMPLETE BUYERS' GUIDE SERVING
THE ENTIRE AEROSPACE INDUSTRY

THE STANDARD PURCHASING REFERENCE OF THE AEROSPACE MARKET

MAJOR PRODUCT CATEGORIES INCLUDE:
AIRCRAFT • AVIONICS
SPACE VEHICLES & MISSILES
SUPPORT EQUIPMENT & ACTIVITIES
AIRPORT & AIRLINE EQUIPMENT

GUIDE ISSUE

AVIATION WEEK's Annual Buyers' Guide is one source for buying information in all segments of the dynamic aerospace industry. It's on the engineer's desk...at his fingertips...readily accessible...with needed information.

The new 1961, 6th Annual Edition, now in preparation, is more complete and essential than ever before, containing expanded listings on new products and companies in new areas of the total market.

It will contain over 50,000 manufacturers' product listings in 1,800 product categories. In addition to being quick and easy to use, the BUYERS' GUIDE includes complete listings of government procurement agencies telling: Where to go; Who to see; What they buy.

BUYERS' GUIDE usage was demonstrated in a survey conducted eight months after publication of the 1958 edition.

71% of respondents still had their copy
60% of this group referred to it at least once a month

This means your advertising is available to the purchaser or specifier at the moment buying information is needed. Its constant reference value and year long life offers multiple exposure of your advertising.

Advertisers' product listings are bold faced and include a reference to the page number of their advertising. In addition to an alphabetical advertisers' index, there is a "product" advertisers' index. To supply you with key industry sales leads the BUYERS' GUIDE contains Reader Service cards.

If you sell to the aerospace industry, your advertising message belongs in the BUYERS' GUIDE—as well as your company's product listings.

PUBLISHING DATE: Mid-December

CLOSING DATE: November 15, 1960

ABC PAID CIRCULATION 78,983

A McGraw-Hill Publication
330 West 42nd Street, New York 36, N. Y.

Aviation Week and **Space Technology**

. . . enables us to take a penetrating look into the fundamental nature of matter.

One of our most challenging research programs is an investigation of the microstructure of solids. By studying defects in minute crystals, we are obtaining greater understanding of these basic building blocks of nature. Eventually, we hope to learn how to modify or eliminate these defects and thus better control the physical and mechanical properties of materials.

If you are interested in corporate-sponsored studies into the fundamental nature of matter, we welcome your inquiry. We offer you a research environment where the scientist receives *real backing:* superior research tools; the use of the nation's largest computational facility; assistance from other scientists with complementary skills.

Please send resume to Mr. W. D. Walsh, at the Research Laboratories.

OPPORTUNITIES for scientists in the physics of solids, liquids, gases, and plasmas. Current studies range from the fundamental properties of matter to the application of scientific knowledge to promising new products.

RESEARCH LABORATORIES
UNITED AIRCRAFT CORPORATION
400 Main Street, East Hartford 8, Conn.

UAC RESEARCH

have been hampered by unexpected weather conditions upon nearing McGrath.

The Board concludes that this accident was entirely operational in nature and that it had its inception in two basic circumstances. One, a pilot of questionable instrument ability became lost and climbed into an area where instrument proficiency was necessary; two, based on the amount of fuel carried and the elapsed time involved, it is likely that fuel exhaustion occurred at approximately the time when control of the aircraft was lost.

Probable Cause

The Board determines that the probable cause of this accident was the pilot's loss of control while flying under instrument flight conditions, and failure to recover control. Contributing factors were poor flight planning, possible fuel exhaustion, and the pilot's lack of instrument proficiency.

By the Civil Aeronautics Board:

WHITNEY GILLILLAND
Chairman

CHAN GURNEY
Vice-Chairman

G. JOSEPH MINETTI
Member

ALAN S. BOYD
Member

J. S. BRAGDON
Member

Supplemental Data

The Civil Aeronautics Board was notified of this accident by the Federal Aviation Agency shortly after occurrence. An investigation was immediately initiated in accordance with Title VII of the Federal Aviation Act of 1958. A public hearing was ordered by the Board and was held at Anchorage, Alaska, Sept. 17, 1959.

Pilot

Chefley W. Priest, age 35, of 1805 30th Street, Spenard, Alaska, held a valid commercial pilot's certificate with multi-engine land and sea ratings. His medical certificate was Class I, without limitations, and had been renewed in June, 1959. Mr. Priest's total piloting time, as stated on his application for his last physical examination in June 1959, was 6,500 hr. Evidence indicates that some of Mr. Priest's piloting had been of a nature requiring instrument flight; however, he did not have an instrument rating.

Aircraft

The aircraft was a Beech, Model C18-S, N 57139. Its registered owner was Donald L. Bailey of the Adwater Hotel, Anchorage, Alaska. The total time on the aircraft was 3,429 hr. and the time since overhaul was 642 hr. Engines were Pratt and Whitney, model R 985-14B. Both had had 642 hr. since overhaul and 29 hr. since periodic inspection. Propellers were Hamilton standard with 642 hr. since overhaul.

Although this flight was being conducted as a charter operation, no Alaskan air taxi operator's certificate, as required by Part 293 of the Board's Economic Regulations, had been issued to or applied for by the operator, Bailey Enterprises, Inc., an Alaskan corporation.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a listing of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Kellett Aircraft Corp., Willow Grove, Penna., group "A" and "B" kits for installation of cameras on projects FS-765-M/F-84F, 44 ea., (of each kit), and technical data, contract AF 33(600)41899, IFB 33-600-60-221, $46,292.

Federal Systems Division, International Business Machines Corp., Owego, N. Y., components of AN/ASB-9A bombing navigation system (varying quantities), for B-52E, F and G aircraft, mod. 1000 program, amendment number 1 to letter contract AF 33(600)40961, $237,108.

Solar Aircraft Co., San Diego, Calif., product improvement of the power and heating auxiliary unit AF type A32A-1 (Solar model T-41M9), data and/or reports, contract AF 33(600)41631, $568,628.

Eclipse-Pioneer Division, The Bendix Corp., Teterboro, N. J., product improvement of central air data computer, engineering services and data, contract AF 33(600) 41763, $90,647.

Bendix Products Division, The Bendix Corp., Teterboro, N. J., product improvement main, 49x17, type VII, contractor's P/N 153245-1, Aerno 41-7006, 1,671 ea. (initial and replenishment spares for KC-135 aircraft), letter contract AF 33(600)41767, $680,097.

The Lewis Engineering Co., Naugatuck, Conn., transmitter, temperature, electrical resistance, Aerno 61-2435, 23,741 ea.; bulb, temperature, electrical resistance, Aerno 61-8909, 2,084 ea., contract AF 33(600) 41947, IFB 33-600-60-241, $122,524.

CHARLES E. McGINNIS
CHIEF COMMUNICATIONS ENGINEER

"Did you know that there are 53 lakes within the city limits of Orlando?"

CAREER OPPORTUNITIES IN FLORIDA. Participate in creative assignments on Army, Navy and Air Force prime contracts — including Pershing, Bullpup, GAM-83 and Lacrosse missiles, Missile Master and other electronic systems. Current openings in design, development, fundamental and applied research, reliability, manufacturing and associated engineering areas. Write C. H. Lang, Director of Employment, The Martin Company, Orlando 9, Florida.

SEE PAGE 109

WORK IN THE CLIMATE OF ACHIEVEMENT

MARTIN
ORLANDO

STRUCTURAL DESIGN ENGINEERS

Two years engineering college plus experience desired. Will be engaged on wing and fuselage design.

STRESS ENGINEERS

Rigorous design requirements necessitate extensive structural investigation of the influence of high temperatures and unconventional external loadings. Stress engineers concerned with such structures will have the opportunity to utilize their technical knowledge to the fullest extent in the development of new analysis methods. Experience plus degree preferred.

For more information please write to: Mr. A. K. Bowman, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
NORTH AMERICAN AVIATION, INC.

FPD PROFESSIONAL EMPLOYMENT NEWS

PUBLISHED BY THE FLIGHT PROPULSION DIVISION OF GENERAL ELECTRIC IN CINCINNATI, OHIO / OCTOBER, 1960

FPD NEWS offers latest information on openings throughout the Division to interested engineers and scientists. Technical information and news relating to current projects will also appear from time to time in this column.

General Electric Forms New Space Power Operation

A new Space Power Operation has been formed by the Flight Propulsion Division to consolidate advances achieved in space power and propulsion during the past 3-4 years. The move will join in a single organization the design and development of systems to power accessory equipment and electrical propulsion engines for advanced outer space vehicles.

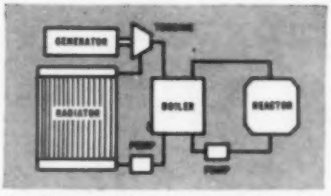
According to FPD General Manager David Cochran, "Progress in the space power field has developed to the point where an organization of this nature can most fully utilize the technology being created." He added that the Space Power Operation would integrate new projects into company-wide space efforts.

Nuclear Power Stressed by Operation Manager

M. A. Zipkin, who previously guided FPD's advanced propulsion systems activities as Manager of Thermodynamics, will head the Space Power Operation. Commenting on the work of his new group, Mr. Zipkin emphasized the high efficiency potential of nuclear-powered turbomachinery.

Investigations already underway are centered on nuclear turbogenerator systems using high temperature liquid metal as the working fluid.

Other future requirements for space power systems have been defined to include power sources for manned and unmanned vehicles on interplanetary probes, lunar-based power sources, power for large orbiting satellites and powered relay communications stations.



Simplified schematic of potassium two-phase power supply. Primary loop carries heat from the reactor to boiler heat exchanger by means of high temperature, high pressure liquid metal. In the boiler, fluid flowing in the second loop is completely vaporized, expands through a turbine driving the electric generator and system pump, passes on to the radiator for condensation and return to the boiler.

Diversified Programs Offer Many Opportunities

Programs of continuing importance at FPD include further development of the J93 engine, to power the B-70 and the CJ-805-23 aft-fan turbojet destined to see commercial airline service next year. Progress in Lift Fan development, new engines and applications, rockets and space propulsion document the greater opportunities for professional achievement at FPD.

Immediate Openings in Space Power Operation and Other Expanding Areas

Liquid Metals Systems / Physical & Analytical Chemistry / Electrical Control Components Design / Engine Controls Systems Design / Thermodynamic Cycle Design Analysis / Metallurgical Engineering / Turbomachinery Design / Ion & Plasma Propulsion / Liquid & Solid Rocket Development

For more information, write informally, or forward your resume in confidence to Mr. Mark Peters, Dept. 64-WO.

FLIGHT PROPULSION DIVISION

GENERAL ELECTRIC

BUILDING 100 CINCINNATI 15, OHIO

PROBING STRUCTURES *for Space...* at AVCO/RAD

Recognized as a pioneer in re-entry and other problems in Space Technology, Avco Research and Development now probes the advanced area of space structures.

Positions are available in preliminary design and structural analysis of manned and un-manned re-entry vehicles, space stations, power supply systems and satellites.

This challenging work requires engineers at the Master's level with a minimum of four years' experience and training in applied mechanics in the field of elevated temperatures or cryogenic structures.

Within Avco's superbly equipped Wilmington facilities, you will find a unique admixture of challenging problems and ample technical support. The facilities are conveniently located to Metropolitan Boston's leading educational institutions and cultural events.

Send resume to J. E. Bergin, Employment Supervisor, Department W-R

AVCO

Research & Advanced Development

A Division of AVCO Corporation

201 Lowell Street, Wilmington, Mass.

ENGINEERS • SCIENTISTS

The

MILITARY COMMANDER

Present day decisions at the highest level of military command require a range and precision of communication and information processing beyond that conceivable in the past. Probably the greatest single new influence on the requirements for the decision-making process is the sharp reduction in reaction time which results from the introduction of the ballistic missile.

To cope with this problem, science and technology must provide the Military Commander with the means to exercise his command effectively. It must give him the facilities by which he can evaluate and extend his control over his weapons. Without such support to the Commander and his command organization, effective peacetime deterrence, wartime defense and retaliation are impossible.

Optimization of the command and control function can be facilitated by electronic systems which collect, transmit, process and display the data required for the decision-making process. These systems involve, to an unusual degree, interrelationships among technical factors, operational factors and the command structure in which the systems are to function. Further, these system requirements cannot be considered independently of the technical capabilities of men and machines.

The MITRE Corporation is a nonprofit organization formed in 1958 under the sponsorship of the Massachusetts Institute of Technology. It provides technical support to the United States Air Force's Command and Control Development Division. *Its nucleus* is composed of the engineers and scientists who designed and developed SAGE – the world's largest real-time control system. *Its task* is to design, develop and evaluate large-scale, computer-based command and control systems. *Its technical competence* and *its objectivity* will provide the Military Commander with compatible systems which meet the standards of technical realism.

THE MITRE CORPORATION

Post Office Box 208, 10-WB—Bedford, Massachusetts

Unusual career openings are available for exceptionally qualified engineers and scientists

ENGINEERS

Bausch & Lomb

A firmly established giant in the optical industry, this upstate New York corporation is rapidly expanding in electronic-mechanical systems work. Emphasis lies in commercial analytical and scientific instrumentation with a healthy balance of research and development contracts for military programs. Look into these professional opportunities with Bausch & Lomb Incorporated.

● PHYSICISTS

Ph.D. or M.S. with experience and/or interest in the following areas: vacuum, solid state optics, infra-red, analytical instruments—to perform research in advance development.

B.S. or M.S. with experience in a standards laboratory or in the development of measuring instruments or methods.

● ELECTRICAL ENGINEERS

B.S. with M.S. desirable. Three or more years experience in circuit design. Instrument experience valuable but not required. Must be capable of working without direct supervision.

● MECHANICAL ENGINEERS

B.S. with M.S. desirable. Must have a strong background in machine design, small mechanisms and instruments. Must be capable of original product design and project responsibility.

B.S. with M.S. desirable and a heavy background in physics and with design experience in the field of analytical or optical instruments.

● INSTRUMENT ENGINEERS

Physicist with 2 or more years experience in optics and electronic instrument research and design.

Mechanical engineer to design ophthalmic machinery, optical or analytical instruments.

● OPTICAL ENGINEERS

B.S. in Optics, M.E. or Physics and 2 or more years experience in optical engineering. Will provide the optical engineering design of a broad line of products.

B.S. with 1 or more years experience in photographic or photogrammetric optical instrumentation.

B.S. with a major or minor in physiological optics and an interest in ophthalmic instruments.

● LIVE IN ROCHESTER

Rochester is located in the heart of the upstate New York vacation country and is noted for its beautiful homes and gardens, fine schools and University, outstanding cultural advantages and high ratio of professional residents.

● YOU ARE INVITED

to forward your resume to H. A. Frye, Professional Employment.

Bausch & Lomb

12 Bausch Street

Rochester 2, New York

PROJECT ENGINEERS

A long established and nationally recognized New York engineering company is seeking outstanding Mechanical Engineers for their Project Engineering Staff

The men we seek should have

- demonstrated technical competence — administrative and leadership ability
- experience in project management and engineering in areas of experimental test cells, wind tunnels, environmental test chambers and missile launching facilities.
- ability to assume responsibility for efficient performance of a project including engineering, design, scheduling and administrative services.

All response will be treated confidentially

P-5441, Aviation Week
Class. Adv. Div.,
P. O. Box 12, N. Y. 36, N. Y.

High level openings for Development Engineers needed for work on advanced aircraft, missile and space vehicle applications.

FLUTTER and VIBRATION SPECIALIST
Degree in Engineering, Physics, or Applied Mechanics with minimum of 5 years experience in aeroelasticity, vibration or flutter. Should have strong theoretical background in unsteady aerodynamics, structural response and applied mathematics or practical experience in dynamics model design and testing, aircraft vibration and flight flutter testing.

DYNAMICS SPECIALIST
Degree in Engineering, Physics, or Applied Mechanics with experience in vibration, transient dynamics problems, structural analysis, analog or digital simulation methods.

THERMODYNAMIC and/or AERODYNAMIC HEATING SPECIALIST
BS or MS in Engineering with 7 to 10 years experience in thermodynamic heat transfer and/or aerodynamic heating. Propulsion experience and rocket background desirable.

For confidential consideration send resume to:

H. L. GORDON
Professional Employment Manager
LOCKHEED AIRCRAFT CORPORATION
834 West Peachtree St. N. W.,
Atlanta 8, Georgia

LOCKHEED — Georgia Division

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITION VACANT

Research Analyst—College degree, transportation major preferred; will consider economics, statistics or accounting degrees. Require minimum of two years airline traffic or financial forecasting. New York location. Submit resume and salary desired to P-5276, Aviation Week.

POSITIONS WANTED

Former airline captain, over 10,000 accident free hours, hold A.R.T., time in DC7, DC6, Convair, DC3, C46. PW-5405, Aviation Week.

POSITIONS WANTED

Pilot, USAF, airline; age 30; employed export sales mgr.; French, Spanish. Desires position utilizing all qualifications, preferably Europe or Latin America. Resume on request. PW-5283, Aviation Week.

Air Force Armament & Electronic Squadron Commander Voluntarily retiring as Lt. Col., 1 Nov 60. Desire challenging position executive flying with potential of working into supervisory capacity. World wide flying experience, light SE through multi-engine jet. Commercial certificate. Varied background in operations, maintenance, personnel management and supervision. Outstanding effectiveness reports. Resume on request. PW-5345, Aviation Week.

Airline Captain, 14,000 hours, successful sales background pharmaceuticals; licensed real estate, insurance. Stich, 46 Turrini Circle, Danville, Calif.

Employed scheduled airline captain age 37 vast experience. ATR typed in DC-3; DC-3S; DC-6; DC-7; Convairs and Martins desires to relocate. Prefer executive flying coupled with sales, PR or personnel work. PW-5414, Aviation Week.

Flight Engineer currently qualified DC6-B DC7-B 1100 hours. A. & E. Immediately available. 2 years college. PW-5403, Aviation Week.

Young Engineer-Pilot. Position utilizing both abilities. BS in Aeronautics. Comm. Pilot SMEL, Inst., A&E. Resume on request. PW-5399, Aviation Week.

Military Systems Program Manager and planner. Diversified, technically-oriented military background. BS (West Point) and post-grad work in EE Control Systems. Created and established Air Force organization managing development major electronic (ESSPO) systems in ARDC. Interested in systems integration management, program planning, or high level representation. Col. Forrest G. Allen, USAF (Ret), 2343 Fox Hills Dr., Los Angeles 64, Calif.

HELICOPTER TEST PILOTS

WANTED FOR

NAVY DASH PROGRAM

to Test and Evaluate
Automatic Stabilization and
Remote Control Equipment

Minimum Requirements

- 500 Hours Rotary Wing Time Preferably Including at least 100 Hours of Test Time
- 1000 Hours Total Flight Time
- 140 lbs. Weight
- College Degree Desirable

Submit resume with salary history and requirements to:

Personnel Director

Gyrodyne COMPANY OF AMERICA, INC.

St. James, L. I., New York

DON'T FORGET

the box number when answering advertisements. It is the only way we can identify the advertiser to whom you are writing.

Strange things happen to a man when you strap him in and shake him like a can of paint.

Why?

What causes his involuntary reactions?

How much can he take?

What moves do you make to counteract the conditions he will face?

Every day, our Research Engineers probe for answers to these and thousands of similar questions. It's exciting, challenging work in a field where the questions still far outnumber the answers. We need Senior Engineers who can help speed up the search.

In fact, Boeing/Wichita is especially interested in talking to experienced Flight Test personnel—electrical instrumentation, ground operations and test operations engineers. The rewards are great and the standards are high. If you're ready for the big move, we'd like to hear from you.

ALL SHOOK UP IN ♂ THE SHAKE SHACK!

Also, opportunities in:
Electronics — Propulsion
Structures — Mechanical Equipment
Aerodynamics

Write in confidence to: Mr. Melvin Vobach
Dept. CO2, Boeing Airplane Co.
Wichita 1, Kansas

BOEING/WICHITA

Equal job opportunities for all qualified applicants

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE:

The advertising rate is $31.00 per inch for all advertising appearing on other than on contract basis. Contract rates on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

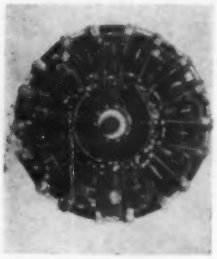
UNDISPLAYED RATE:

$2.70 a line, minimum 3 lines. To figure advance payment count 8 average words as a line.

PROPOSALS, $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.



Want more dependable engines and engine overhauls?

Write, wire or telephone:

STEWARD-DAVIS

Gardena, Calif./Cable: STEDAV
Phone: FAculty 1-3414/FAA Approved Agency 4044

Reciprocating engines:

R-1820, R-1830, R-2000, R-2600, R-2800-C, CA, CB engines and overhaul services. Unusual test, overhaul, service, and propulsion development problems welcomed.

C-82, C-119, JET-PACKET Transports

Inventories of aircraft, parts, engines, and engineering. Transports bulky loads which cannot be loaded into other aircraft. Ideal flight research aircraft.

Turbojet engines:

Westinghouse J-30 (1600 lbs thrust), J-34 (3400 lbs.), Continental J-69 (1000 lbs.). Also auxiliary JET-PAK's for installation on underpowered aircraft.

CONVAIRS
Airline and Executive
Several of Both Available

Convair Trade-In
DOUGLAS DC-3
200 M.P.H. A12 Autopilot
Trades Accepted

DOUGLAS DC-6
DC-6A DC-6B
Finance or Lease

Also Grumman Twin Beech and Lockheeds in Stock

Contact:
Frederick B. Ayer & Associates, Inc.
250 Park Avenue, New York 17, New York

WHERE TO BUY

Featuring additional products, specialties & services for the aviation field

FASTENERS FOR AIRCRAFT AND MISSILES
Immediate Delivery—AN—N.A.S.—M.S.—6 Digit
CERTIFIED TO GOVERNMENT SPECIFICATIONS
Bolts—Nuts—Rivets—Screws—Studs—Internal and External Wrenching Bolts—Dowel and Lock Pins

Mercury air parts co., inc.
9310 West Jefferson Blvd., Culver City, Calif.
Telephone—UPton 0-5923—Teletype—CVR CY 4138
TOUGH SPECIALS 10 DAY DELIVERY
MANUFACTURERS OF PRECISION HARDWARE

FOR SALE

LOCKHEED LODESTARS

Wright 1820-56A Engines—HSP 33D50 Props—1350 HP for T.O.—19,500 lbs. Gross Weight—De-icer Boots—Learstar Rudder Tabs—Fuselage Saddles—Sierracin Electrically Heated Windshield—CB Fire Extinguisher—Edison Fire Detection—Sperry Integrated Instrument System—Collins 51R3 NAV—ARC Type 15 NAV—Dual ADF—Collins 17M1-51X1A and ARC 210 Communication System—Bendix RDR1C Radar—2500 VA Inverters—Executive Interior—Divan—6 Seats—Tables—Closet—Lavatory—Complete Galley—Asking $50,000—Spares Available—Brokers Protected.

Contact: **Air Transport Department**
Continental Can Company, Inc.
Box 791, Morristown, N. J.
Jefferson 8-3070

EXECUTIVE DC-3

RADAR—A-12 AUTOPILOT
1830-94 Engines—*Excellent Condition*
FOR SALE OR LEASE—*Will trade*
WILLIAM C. WOLD ASSOCIATES
551 FIFTH AVENUE, NEW YORK 17, NY
Tel: Murray Hill 7-2050 Cable: Billwold New York

OXYGEN EQUIPMENT
SALES & SERVICE
REGULATORS — MASKS — VALVES
PORTABLES & CYLINDERS
FIXED INSTALLATIONS
GOVT. APPROVED REPAIR STATION
ZEP AERO Phone: ORegon 8-1161
EL SEGUNDO, CALIFORNIA

Exceptional Executive 1956 E18S

Low Time Engines
Excellent Electronics
Available Immediately
CALL Digby 9-3140 (NYC)
Linden Flight Service, Inc., Linden, N. J.

FOR SALE OR LEASE **MARTIN 202**
44 passenger airline interior, reversible props, heavy landing gear, airline radio
Airframe—192 hours since progressive overhaul
Low Time Engines—Available Immediately
Will ferry at cost anywhere. Price $125,000 with spare NTSO demountable power plant
"Will also consider a light twin in trade"
CHARLOTTE AIRCRAFT CORPORATION
P. O. Box 9127 Charlotte, N. C.

For sale or lease
Newly overhauled
C46F
Low time
C46As
Call/write for information
AAXICO
Box 48-875, Miami 48, Fla., (TU 7-1541)

ADDRESS BOX NO. REPLIES TO: Box No., Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

FOR SALE

PBY, SA. Tow amphibian converted for 2 crew—cargo—passenger use. FS-3404, Aviation Week.

S-55 Helicopters, 8-place or cargo plus crew completely overhauled, licensed and refinished, like new. Four available. N. A. Kalt, P. O. Box 1738, San Antonio, Texas. CApital 4-8434.

Aero Commander, 560A, low-time, newly painted, well equipped. Leeward Aeronautical Sales, Inc., Box 48-233, Miami, Fla. TU-75527.

Executive DC-3, beautiful plush interior (top condition), picture windows, Dual maximum instrumentation vac. & elec., Dual 360 channel VHF, Dual Collins Omnis with R.I.I., Low time since overhaul; located Baer Field, Ft. Wayne, Ind. J. K. Leeward. Phone H-28211, S-9211.

Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and—more advertisers mean more information and more products or better service—more value—to YOU.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, OCTOBER 10, 1960

AIR-MAZE, A SUBSIDIARY OF ROCKWELL-STANDARD CORP. 75
AIRWORK CORPORATION 67
ALUMINUM COMPANY OF AMERICA, MISSILES, AVIATION ORDNANCE 36
AMERICAN CAR & FOUNDRY DIV. OF ACF INDUSTRIES, INC. 78-79
AMERICAN CHAIN & CABLE CO., AUTOMOTIVE & AIRCRAFT DIV. 77
AMERICAN MACHINE & FOUNDRY COMPANY 18
AMPLIVOX, LIMITED 87
ANELEX CORPORATION 5
ASSOCIATED AIRCRAFT INDUSTRIES 83
AVIATION WEEK AND SPACE TECHNOLOGY 124-125
AVNET ELECTRONICS CORPORATION 15

BARBER-COLMAN COMPANY, AIRCRAFT CONTROLS DIVISION 86
BELL AEROSYSTEMS COMPANY 35
BELL HELICOPTER COMPANY 102
BENDIX COMPUTER DIVISION, THE BENDIX CORPORATION 64
BENDIX ECLIPSE-PIONEER DIVISION, THE BENDIX CORPORATION 53
BENDIX SYSTEMS DIVISION, THE BENDIX CORPORATION 101, 113
BETHLEHEM STEEL COMPANY 14
BRISTOL SIDDLEY ENGINES, LIMITED 80-81
BRUNSWICK CORPORATION 129
BULOVA RESEARCH & DEVELOPMENT LABORATORIES, INC. 70
BURNDY CORPORATION 9
BURROUGHS CORPORATION 48

CANADAIR LIMITED 46
CATERPILLAR ENGINE DIVISION OF CATERPILLAR TRACTOR CO. 96
CENTURY ELECTRONICS & INSTRUMENTS, INC. 96
COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC. 10, 121, 122
COMPUTER SYSTEMS, INC. 82
CONSOLIDATED ELECTRODYNAMICS CORP. 85
CONTINENTAL-EMSCO COMPANY 56
CONVAIR DIVISION OF GENERAL DYNAMICS CORP. 113, 117
COOPER PUBLICATIONS, INC., GEORGE 96
CORNELIUS COMPANY, THE 22

EASTMAN KODAK COMPANY 60-61
ELECTRO-MECHANICAL RESEARCH, INC. 6
ETHIOPIAN AIRLINES, INC. 47
EXECUTIVE AIRCRAFT SERVICE, INC. 87

FLEXONICS CORPORATION 17

GARRETT CORPORATION, THE 116
GENERAL ELECTRIC COMPANY 24
THE B. F. GOODRICH COMPANY, AVIATION PRODUCTS 91
GOODYEAR AIRCRAFT CORPORATION, THE 3
GRUMMAN AIRCRAFT ENGINEERING CORPORATION 8

HALOID XEROX INC. 16
HAMILTON STANDARD DIVISION, UNITED AIRCRAFT CORP. 104-105
HUGHES AIRCRAFT COMPANY 68-69

KAYNAR MANUFACTURING COMPANY, INC. ..... 2nd Cover
KINETICS CORPORATION 84

LABORATORY FOR ELECTRONICS, INC. ..... 3rd Cover
LEWIS ENGINEERING COMPANY 91
LITTON INDUSTRIES, ELECTRONIC EQUIPMENT DIVISION 95, 107
LOCKHEED AIRCRAFT COMPANY 92-93, 123
LOS ANGELES DIVISION OF NORTH AMERICAN AVIATION, INC. 127

MAGNAVOX COMPANY, THE, GOVERNMENT & INDUSTRIAL DIV. 98
MARCONI WIRELESS TELEGRAPH CO., LTD. 118
MARTIN COMPANY, MARTIN ORLANDO DIVISION 100, 121, 122
MIDVALE-HEPPENSTALL COMPANY 106
MILLER ELECTRIC MFG. COMPANY 83

MINNEAPOLIS HONEYWELL REGULATOR COMPANY 133
MINIATURE PRECISION BEARINGS, INC. 11

NORTH AMERICAN AVIATION, LOS ANGELES 122

OSTER MFG. CO., JOHN (AVIONICS DIV.) 114

PRATT & WHITNEY AIRCRAFT DIV., UNITED AIRCRAFT CORPORATION 44

RAYBESTOS-MANHATTAN, INC., REINFORCED PLASTICS DIV. 110
RAYTHEON COMPANY 4
RAYTHEON COMPANY, EQUIPMENT DIVISION 7
REEVES INSTRUMENT CORPORATION 54
REPUBLIC AVIATION CORPORATION 74
RESEARCH LABORATORIES DIV., UNITED AIRCRAFT CORP. 126
ROHM & HAAS COMPANY, PLASTICS DIVISION 110-111
RYAN AERONAUTICAL COMPANY 90

SEISCOR, A DIVISION OF SEISMOGRAPH SERVICE CORP. 94
HRB SINGER DIVISION, SINGER MILITARY PRODUCTS, INC. 72
SOLAR AIRCRAFT COMPANY 80
SPACE TECHNOLOGY LABORATORIES, INC., SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE CORP. 20
SPRAGUE ELECTRIC COMPANY 112
STANDARD PRESSED STEEL COMPANY 12
STONER RUBBER COMPANY 97
SYSTEM DEVELOPMENT CORPORATION 76

THOMPSON RAMO WOOLDRIDGE INC., TAPCO GROUP 13

U.S.A.C. TRANSPORT, INC. 100

VARIAN ASSOCIATES, TUBE DIVISION ..... 4th Cover

WESTINGHOUSE ELECTRIC CORP., DEFENSE PRODUCTS GROUP 56
WHITNEY METAL TOOL COMPANY 97

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

WHERE TO BUY
Mercury Air Parts Inc. 132
EMPLOYMENT OPPORTUNITIES 128-131
EQUIPMENT
(Used or Surplus New)
For Sale 132

ADVERTISERS INDEX

AAXICO 132
Avco Research & Advanced Development Corp. 128
Ayer & Associates, Inc., Frederick R. 132
Bausch & Lomb Inc. 130
Boeing Airplane Co. 131
Charlotte Aircraft Corp. 132
Continental Can Co., Inc. 132
General Electric Co., Flight Propulsion Dept. 128
Gyrodyne Co. of America, Inc. 130
Linden Flight Service Inc. 132
Lockheed Aircraft Corp. 130
Mitre Corp., The 129
Steward-Davis Inc. 132
Weld Associates, William C. 132
Zep Aero 132

Join the

Honeywell

Marine Systems Group

Challenging career opportunities await you at Honeywell where exciting projects such as the electrically suspended gyro, the rotor of which is seen here, are developed. Specific openings include:

INERTIAL SYSTEMS ANALYST

Mathematician or engineer with strong background in vector analysis, operational calculus, matrix algebra and related techniques, to carry out analysis of inertial systems configurations including error evaluation.

DIGITAL SYSTEMS AND LOGIC DESIGNER

Familiar with digital logic techniques at current state of the art; capable of organizing computing systems to perform various tasks including logical design and critical parameter specifications.

ELECTRONIC ENGINEER

Electrical engineering degree plus experience in miniaturized semiconductor electronics development. To design servo, pickoff, and other electronics for use with gyros and accelerometers.

ENGINEERING PHYSICIST

Physicist with practical and theoretical understanding of mechanics, magnetism and electricity to analyze and develop inertial sensors of novel and original design.

To discuss these or other openings, write Mr. James H. Burg, Technical Director, Dept. 828, Aeronautical Division, 1433 Stinson Blvd., Minneapolis 13, Minn.

Honeywell

Military Products Group

To explore professional opportunities in other Honeywell operations coast to coast, send your application in confidence to H. K. Eckstrom, Honeywell, Minneapolis 8, Minn.

LETTERS

Sharing Midas

Why hasn't someone suggested that we invite the USSR to share our DEW Line, BMEWS, and especially Midas systems with us? It would solve several problems. For one thing, it would give unequivocal assurance to everyone that the United States is not planning a nuclear surprise party for Russia. News surrounding the recent U-2 incident seems to show that the Russians are rather apprehensive of such an attack. If they lack confidence in the protection of their retaliatory forces, they may well be tempted in desperation to essay a preemptive attack on the United States. True, the chance of a calculated attack would be unaffected, but we would at least reduce the chance of "accidental" war.

For another thing, the Midas system on which we are pinning our hopes is distinctly vulnerable. Informed people say that the Russians can and will intercept our vehicles when they attain any military value. If a warning system is really working, and not just an empty bluff, then an attack on it necessarily implies the intention to start a war. There is, however, no such inhibition against bringing down a Midas vehicle over Russian soil, at least under present circumstances. Quite to the contrary, the Russians would probably acclaim it as a scientific and "peaceful" achievement.

Now, it seems, the United States is in a unique position to turn the situation to advantage. In effect we can give up our ability to make a surprise attack (which we publicly renounce anyway) in exchange for greater security against a surprise attack by the Russians. This depends on arranging our warning systems so that they are of no possible benefit to the user except for the one purpose of warning against a surprise attack, and then sharing them with the Russians through some agency such as the UN. It would be difficult for the Russians publicly to refuse such an offer, and once having accepted it they could no longer attack its implement, such as a Midas vehicle, with impunity. In fact, this appears to be the only device by which the Midas system could be preserved.

Note that this suggestion has nothing to do with spy systems, open skies, and similar nonsense. An offer to swap secret target locations is patently ridiculous. The U-2 is gone forever, and nothing will bring it back. Samos is doomed before it ever gets off the ground. The only thing that can be saved is a system which does not pry into private affairs and does not reduce the defensive ability of either side.

This could be done by inviting UN monitors to our strategic warning ground sites; or we could convert our external radar warning network for operation by the United Nations; or we could merely arrange the Midas vehicles so that data is available to anyone. The important thing is to make the offer free with no strings attached. Any attempts to dicker would merely result in parliamentary strangulation by the Russians.

By the way, I might point out that we would not be giving up very much. DEW Line and BMEWS are practically outflanked. Midas is still some time off, and some day the advent of strategic submarine-launched missiles will make the whole thing academic.

I have thought this over for several months now. Although I don't feel like debating the issues myself, I think I know what the most important ones are:

How sincere is the U. S. intention not to attempt a surprise attack?

How much confidence can be placed in warning from a given system?

How important is the risk of "accidental" war?

Is a sharing scheme technically feasible, from the standpoint of equipment, deployment, operation, and security?

NAME WITHHELD ON REQUEST

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Annoying Editorials

Your editorials are annoying. In them you display a complete lack of comprehension and broadmindedness, both in presentation and content.

I am delighted that you are not directing the country's fiscal policies, and that your cries go unheeded. You would have us a nation of Mach 3 atom bombers, globe-circling missiles, one-room schools and pockmarked dirt roads.

There are other items on the country's budget besides aviation.

G. T. FLEMING
Corporation Pilot
Sierra Madre, Calif.

Coffee Break

In the July 25 issue of AVIATION WEEK (p. 26) appears an excellent and stimulating article on "Pyrolytic Graphite Studied for Re-Entry." While the subject was most adequately covered and the method of operation of pyrolytic graphite clearly described, there appears to me to be an error in one of the statements made concerning the increase of radiative transfer of heat with temperature.

The statement is made "But radiation rises by a factor of 2^4 with temperature." It seems to me that the statement should read: radiation rises by a factor of T^4 with temperature.

An amusing problem has been devised along this line. The problem is: given two cups of hot coffee, identical in all respects including temperature, which will be cooler at the end of time, t.; the cup which was let alone from time zero when it was poured until just before, t., and then had cool cream added to it, or the cup which had the cream added at time zero and was allowed to stand at the same ambient temperature as the first cup until time, t.?

The difference in temperature between the two cups of coffee is very small, but there will be a difference. The answer—I leave that to the reader.

As always I find AVIATION WEEK an excellent and most of the time accurate reporter of timely news and a strong voice for quality, quantity and ability of the defense system for the U. S. My only wish is that more "average Americans" could read its pages and see how their money is spent rather than sit back and let "someone else" do it while all the time complaining bitterly that taxes are too high.

A. N. TSCHAECHE
Los Angeles, Calif.

(Mr. Tschaeche, of course, is right. It should be T^4 and not 2^4. As to the problem Mr. Tschaeche raises in regard to the temperature of the two cups of coffee, the answer depends upon a number of factors besides radiation. There is, for example, the matter of fat globules from the cream which act as a surface insulator. And, of course, there is the matter of a black body (that is, the coffee without cream) being a better radiator than a lighter body.

Our answer is that the cup of coffee to which the cream is added just before the end of time will be the cooler. However, we have heard that a maker of soluble coffee actually ran a test on this problem and found no "perceptible" difference in the temperatures of the two cups of coffee.—Ed.)

Eglin Range

In the Production Briefing column on p. 114 of your Aug. 15 issue, Vitro Corp. of America was reported receiving a contract for operation and maintenance of the Eglin Gulf Test Range. The item also stated that Vitro designed and laid out the range system nine years ago.

Like many range projects in the missile and space business, the development of the Eglin Gulf Test Range appears to have been divided among a number of contractors, one of which was the Electronic Engineering Co. of California. EECO, under contract AF 08(603)-3189 made a study dated 24 May, 1957, for the design of range instrumentation facilities at the Eglin Gulf Test Range. The contract was under the cognizance of the Air Proving Ground Command. In letting the contract for construction of the range instrumentation facilities, the EECO report was used verbatin as part of the specifications.

ITT Laboratories of Nutley, N. J., was the successful bidder. EECO was awarded a subcontract by ITT Labs for instrumentation timing systems, telemetry playback and radar data systems.

The Vitro Corp. has worked with the Air Research and Development Command when both APGC and ARDC had joint cognizance of Eglin facilities. This undoubtedly would account for some of the confusion in the giving of credit for design of this range.

R. F. LANDER
Public Relations/Advertising
Electronic Engineering Company of California
Santa Ana, Calif.

LFE

is experienced... in Ground Support Equipment

Before this familiar signal can be given, the intricate electronic circuits of an airborne weapon system must be thoroughly checked.

For 15 years, LFE has devoted extensive research to the development of advanced microwave test equipment for Ground Support. The results have made available many designs that solve difficult and complex radio-frequency measuring problems. Some of these designs are now being used in highly-advanced Ground Support Equipment such as LFE's AN/GPM-24. This self-contained portable tester for airborne doppler navigation equipment is one of the GSE items in quantity production at LFE.

We invite inquiries concerning radio frequency measuring problems for which no pat solution exists.

LFE

LABORATORY FOR ELECTRONICS, INC., Boston 15, Massachusetts

SYSTEMS, EQUIPMENT & COMPONENTS FOR AIRBORNE NAVIGATION • RADAR and SURVEILLANCE
ELECTRONIC DATA PROCESSING • AUTOMATIC CONTROLS • GROUND SUPPORT • AIR TRAFFIC CONTROL

UNIVERSITY MICROFILM INC
STEVENS RICE GS H
313 N 1ST ST
ANN ARBOR MICH C

THE SIMPLEST WAY TO STABILIZE MICROWAVE FREQUENCIES?

Short-term frequency stability as high as one part in 10^9, plus substantial noise reduction, can be achieved by a VARIAN STALO which is a combination of klystron local oscillator and stabilizing cavity. The stalo cavity is a hollow shell—highly refined.

By means of passive stabilization, this cavity in many applications accomplishes the same ends as either active AFC stabilization systems or crystal-plus-electronic-multiplier circuits. But the stalo cavity, because it is passive, has extreme reliability and an infinite life. Most of them require no troubleshooting or maintenance effort—ever—once they have been properly designed and installed in a microwave circuit.

Varian offers stalo cavities to match every klystron oscillator in its present catalog, providing stabilization at any desired frequency in C-band, X-band or K-band. Application Engineering Bulletins 14 and 15, on passive stabilization and on phase locking respectively, fully explain the stalo principle of operation and application to microwave circuits. May we send you copies?

VA-1299 Stalo Cavity shown with VA-201B Klystron

GENERAL CHARACTERISTICS OF VARIAN STALOS

(Exact specifications on individual models available in catalog and data sheets)

Short-term frequency stability	As high as 1 part in 10^9
Long-term frequency stability	As high as 1 part in 10^7
Stabilization factor	As high as 100
Noise reduction	Typically by a factor of 20 as compared to the klystron without stalo cavity
Unloaded Q	As high as 150,000
Temperature compensation	As close as one part in 10^6 per degree Centigrade
Tunability	Fixed frequency or tunable types covering as high as 10% of frequency
Environmental tolerance	Suitable for airborne service
Cavity size and weight	Comparable to or less than active stabilization circuits of similar embodiments

Representatives thruout the world

VARIAN associates
PALO ALTO 22, CALIFORNIA

KLYSTRONS, WAVE TUBES, GAS SWITCHING TUBES, MAGNETRONS, HIGH VACUUM EQUIPMENT, LINEAR ACCELERATORS, MICROWAVE SYSTEM COMPONENTS, NMR & EPR SPECTROMETERS, MAGNETS, MAGNETOMETERS, STALOS, POWER AMPLIFIERS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES